FILED UNDER SEAL PURSUANT TO PROTECTIVE ORDER

Exhibit C

to the Declaration of Dat Nguyen in Support of KAIFI's Motion for Leave to Amend Infringement Contentions

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

KAIFI LLC, Plaintiff, v. T-MOBILE US, INC.; LAYER3 TV, INC.; L3TV DALLAS CABLE SYSTEM, LLC; METROPCS TEXAS, LLC; T-MOBILE LICENSE LLC; T-MOBILE USA, INC.; T-MOBILE WEST LLC; T-MOBILE WEST TOWER LLC; IBSV LLC; THEORY MOBILE, INC.; T-MOBILE PCS HOLDINGS LLC; T-MOBILE RESOURCES CORPORATION; and T-MOBILE SUBSIDIARY IV CORPORATION Defendants.	Case No. 2:20-CV-00281 JRG JURY TRIAL DEMANDED Honorable Rodney Gilstrap

KAIFI'S DISCLOSURE OF ASSERTED CLAIMS & INFRINGEMENT CONTENTIONS

Pursuant to Local Patent Rules 3-1 and 3-2 and the Court's Scheduling Order (Dkt. 24), Plaintiff KAIFI LLC ("KAIFI") hereby provides its disclosure of asserted claims and infringement contentions, including by reference the entirety of the attached appendices, exhibits, and accompanying document production, against Defendants T-Mobile US, Inc.; Layer3 TV, Inc.; L3TV Dallas Cable System, LLC; MetroPCS Texas, LLC; T-Mobile License LLC; T-Mobile USA, Inc.; T-Mobile West LLC; T-Mobile West Tower LLC; IBSV LLC; Theory Mobile, Inc.; T-Mobile PCS Holdings LLC; T-Mobile Resources Corporation; and T-Mobile Subsidiary IV Corporation (collectively, T-Mobile).

KAIFI makes these disclosures based upon presently known and publicly available

information. KAIFI has not completed its preparation of this matter for trial and has not received discovery from each Defendant, particularly discovery of each Defendant's confidential, proprietary, or non-public information and documents that describe the accused instrumentalities, or discovery on each Defendant's past, discontinued, or other instrumentalities reasonably similar to the presently accused instrumentalities. Because KAIFI's investigations are ongoing and discovery is not yet complete, KAIFI reserves the right to amend or supplement its asserted claims and infringement contentions, including the identification of claims infringed by T-Mobile and of the accused instrumentalities. Additionally, KAIFI reserves the right to amend and further supplement its infringement contentions as any additional instrumentalities come into existence or become known.

I. DISCLOSURES

A. Asserted Claims

Pursuant to P.R. 3-1(a), KAIFI presently identifies the following Asserted Claims of U.S. Patent No. 6,922,728 (the "'728 Patent"): Claims 1–7, 9–15, and 17–21.

KAIFI reserves the right to amend this list of Asserted Claims as additional information becomes available to it.

B. Accused Instrumentalities

Pursuant to P.R. 3-1(b), KAIFI presently identifies the following accused instrumentalities that infringe the Asserted Claims: T-Mobile's system and service for voice/data communications network connecting and roaming ("Accused Instrumentalities").

The Accused Instrumentalities include mobile devices sold by T-Mobile and its affiliates.

The Accused Instrumentalities include configurations for implementing T-Mobile's voice/data communications network connecting and roaming system and service, including but not limited to T-Mobile's Wi-Fi Calling and IP multimedia services, for example T-Mobile's Wi

Fi Calling; T-Home Internet (including its LTE and 5G networks); T-Mobile Wi-Fi Services (including Wi-Fi hotspots); T-Vision; Binge On; Music Freedom; and any and all "over the top" media streaming services and IP Multimedia Subsystem services.

Further identification of the Accused Instrumentalities is provided in Appendix 1, as referenced below. Because certain features and components of the Accused Instrumentalities are not publicly available and not determinable from simple inspection, KAIFI herein relies on publicly reported identification of the features and components of the Accused Instrumentalities. During discovery, KAIFI anticipates that T-Mobile will provide a definitive list of their Accused Instrumentalities and its components, configurations, and implementations.

C. Claim Charts

Pursuant to P.R. 3-1(c), KAIFI provides claim charts, which are incorporated by reference as if fully set forth herein. These charts are exemplary and not limiting, and address the Asserted Claims and Accused Instrumentalities without the benefit of full discovery. Citations included in the charts are exemplary only, and should not be construed as limiting.

Appendix 1 is a representative example of the Accused Instrumentalities as implemented for T-Mobile's Wi-Fi Calling. The Accused Instrumentalities utilize the same or substantially similar technology as presented in the chart of Appendix 1, such that the chart is representative of the manner of infringement across the Accused Instrumentalities. The comparisons made in these contentions are representative of, and apply to, all of the Accused Instrumentalities and their configurations and implementations.

For the reasons defined and described in more detail in Appendix 1, the Accused Instrumentalities infringe the Asserted Claims. KAIFI believes that the Accused Instrumentalities may be provided in a variety of configurations or combinations for implementing roaming for any IP-based applications (IP multimedia services), such as browsing

and media streaming, in addition to calling.

Through reasonable investigation of presently known and publicly available information, including T-Mobile's own public websites, disclosures, advertisements, patents, and patent applications, KAIFI has identified what it believes to be the current configurations or combinations of the Accused Instrumentalities. However, KAIFI anticipates that the full scope of configurations or combinations of the Accused Instrumentalities will be found through subsequent discovery from T-Mobile and third parties.

In the attached chart, for convenience, KAIFI has subdivided each Asserted Claim to better explicate where each claim element or step may be found within the Accused Instrumentalities. These subdivisions should not be taken as an indication of the boundaries of claim elements or steps with respect to the doctrine of equivalents or any other issue. Furthermore, the Accused Instrumentalities may infringe the Asserted Claims in multiple ways. KAIFI reserves the right to provide alternate claim mapping, and to amend or supplement its chart.

D. Contentions

Pursuant to 35 U.S.C. §§ 271(a), (b), and/or (c), KAIFI contends that T-Mobile directly infringes the Asserted Claims by making, using, selling, offering to sell, and/or importing Accused Instrumentalities in the United States, the State of Texas, and the Eastern District of Texas.

KAIFI also contends that each Defendant indirectly infringes by actively, knowingly, and/or intentionally inducing or contributing to the direct infringement of the Asserted Claims, literally, under the doctrine of equivalents, and/or jointly, in the United States, the State of Texas, and the Eastern District of Texas.

Such indirect infringement includes each Defendant's inducement through affirmative

acts of each other Defendant, customers, and third parties, and the customers of each other Defendant and third parties, such as wireless subscribers and/or Internet service users, to directly infringe the '728 Patent under 35 U.S.C. § 271(b) by making, using, selling, offering for sale, and/or importing in the United States the Accused Instrumentalities. Each Defendant specifically intended and was aware that the ordinary and customary use of the Accused Instrumentalities would infringe the '728 Patent. Defendants, at least, had knowledge of the '728 Patent and its infringement through its relationship with Google-Fi. Google Fi, a mobile virtual network operator, which operates, under contract, on the T-Mobile network and uses T-Mobile's instrumentalities has been aware of the '728 patent since at least September 3, 2015, when Google Fi was put on notice of Infringement of the '728 Patent. As Google Fi's infringement of the '728 Patent was facilitated and enabled by the use of the T-Mobile instrumentalities, T-Mobile is understood to have been aware of its infringement of the '728 patent, since approximately September 2015. Further Google, the operator of Google Fi, has likely been aware of the '728 patent, at least since November 13, 2014, when it acquired two patents, U.S. Patents Nos. 8,977,275 and 9,014,705; from Motorola Mobility LLC, who had previously identified the pre-patent publication that issued as the '728 Patent as prior art to the two acquired patents.

The affirmative acts of inducement by T-Mobile include, but are not limited to, any one or a combination of encouraging and/or facilitating third party infringement through the advertisement, marketing, and dissemination of the Accused Instrumentalities and their components, including via T-Mobile's wireless subscribers and/or Internet service users; and creating and publishing promotional and marketing materials, supporting materials, product manuals, and/or technical support and information relating to the Accused Instrumentalities,

including but not limited to Wi-Fi Calling and off-loading to a Wi-Fi network, which describe, train, and instruct users on the implementation of the Accused Instrumentalities and their components, including but not limited to mobile devices, Wi-Fi networks, and cellular netowrks.

T-Mobile knew that the induced conduct would constitute infringement, and intended said infringement at the time of committing the aforementioned acts, such that those acts and conduct have been and continue to be committed with the specific intent to induce infringement, or to deliberately avoid learning of the infringing circumstances at the time these acts were committed, so as to be willfully blind to the infringement it induced.

Such indirect infringement also includes T-Mobile's contributing to the direct infringement of the '728 Patent by each other Defendant, customers, and third parties, and the customers of each other Defendant and third parties, by making or selling parts, components, or intermediate products to each other Defendant, customers, or third parties that, once assembled, infringe upon the '728 Patent by the sale and/or use of the assembled products. The Accused Instrumentalities are not staple articles of commerce because they have no substantial non-infringing uses, and embody the heart of the patented invention. Any alleged non-infringing uses would be unusual, impractical, occasional, aberrant, or experimental.

T-Mobile took active steps to encourage end users to use and operate the Accused Instrumentalities, including but not limited to Wi-Fi Calling and off-loading to a Wi-Fi network, despite knowing of the '728 Patent in the United States, in a manner it knew directly infringes each element of at least claim 1 of the '728 Patent. Further, T-Mobile provided product manuals and other technical information that cause their subscribers, customers, and other third parties to use and to operate the Accused Instrumentalities for their ordinary and customary use, such that T-Mobile's customers and other third parties have directly infringed the '728 Patent, through the

normal and customary use of the Accused Instrumentalities. Therefore, each Defendant is liable for infringement of the '728 Patent and that infringement has been and continues to be willful in nature.

Based on publicly available information, and with KAIFI's investigation and discovery ongoing, KAIFI presently contends pursuant to P.R. 3-1(d) that each element, step, and limitation of each Asserted Claim is literally present, met, or implemented in and/or by the Accused Instrumentalities. To date, T-Mobile has not specifically identified which claim elements and limitations it contends are not literally met by the Accused Instrumentalities. Therefore, each claim element and limitation is literally met by the Accused Instrumentalities.

Should any Defendant contend that any element, step, or limitation is literally absent in an Accused Instrumentality, KAIFI contends and reserves the right to prove that at least the equivalent of the allegedly missing element, step, or limitaiton is nevertheless present in the Accused Instrumentality, and that the Accused Instrumentality thus at least infringes under the doctrine of equivalents.

To the extent that T-Mobile contends that the preamble of the Asserted Claims is limiting, KAIFI contends and reserves the right to prove that the limitation is nevertheless present in the Accused Instrumentalities, and that the Accused Instrumentalities thus infringes.

The claim chart provided by KAIFI in the attached appendix applies to KAIFI's claims for direct and indirect, literal and doctrine of equivalents infringement.

E. Priority Dates

The '728 Patent claims priority to Korean Patent Application No. 2001-34976, filed on June 20, 2001.

F. Plaintiff's Instrumentalities Practicing the Claimed Invention

KAIFI is not asserting that any of its products practice, incorporate, or reflect the

Asserted Claims of the '728 Patent.

II. DOCUMENT PRODUCTION

Pursuant to P.R. 3-2(b), KAIFI identifies documents bearing the identification numbers KAIFI_0006982 – KAIFI_0006998.

Pursuant to P.R. 3-2(c), KAIFI identifies documents bearing the identification numbers KAIFI_0007016 – KAIFI_0007164.

Date: October 30, 2020

Respectfully submitted,

/s/ Vincent M. Pollmeier
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing document was served via electronic mail to opposing counsel of record, on October 30, 2020, at the following email addresses:

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APPENDIX 1
Claim Chart for U.S. Patent No. 6,922,728

Claim Term	Accused Instrumentality
1. An internet network connecting and roaming system providing internet communication service to a data communication terminal of a user moving indoors or outdoors, using an outdoor wireless internet network including an antenna, a router and a location register, and an indoor network including an indoor gateway connectable with an internet network, the system comprising:	The Accused Instrumentalities provide an internet network connecting and roaming system. The preamble of this claim is not limiting, and the body of the claim defines the complete invention. However, should the preamble be construed to be limiting, KAIFI contends that Defendants' Accused Instrumentalities would satisfy the preamble because the Accused Instrumentalities provide an internet network connecting and roaming system providing internet communication service to a data communication terminal of a user moving indoors or outdoors, using an outdoor wireless internet network including an antenna, a router and a location register, and an indoor network including an indoor gateway connectable with an internet networks, as described in more detail below with regard to the body of this claim. As a representative example of T-Mobile's infringement, this chart maps the Accused Instrumentality for implementing T-Mobile's Wi-Fi Calling system and service. T-Mobile's system enables "Wi-Fi Calling" which allows a user to make and receive calls and texts over a Wi-Fi connection.[1] **What is Wi-Fi calling?** − Wi-Fi Calling allows customers to make and receive calls and texts (SMS & MMS) over a Wi-Fi connection. Using Wi-Fi Calling is easy–customers won't even know they're making a Wi-Fi call. Simply connect to an available Wi-Fi network with a Wi-Fi calling-enabled smartphone and continue to make a call or send a text as you would over a cellular connection. No separate app or log-in or number is needed. T-Mobile's Wi-Fi Calling enables seamless switching or hand-off between its cellular (LTE) network and a Wi-Fi network.[2]

I know what Wi-Fi calling is. What's next-gen Wi-Fi calling?

With next-gen Wi-Fi Calling, T-Mobile is pioneering a seamless handover between our LTE network and any available Wi-Fi connection so calls don't drop between the two. Next-gen Wi-Fi Calling also features HD Voice quality, when calling another HD Voice-capable user. This means our customers can now maintain crystal clear HD Voice calls, whether connected to T-Mobile LTE or Wi-Fi–all using their existing T-Mobile number.

Wi-Fi Calling enables Defendants' mobile and internet subscribers to "[e]xtend coverage in areas where no cellular network reaches."[3]

This a function of the LTE/EPC Network established by T-Mobile.[4]

> Think of this as a use case: you carry a device that can access, among other technologies, LTE and WiFi. You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi. The EPS network then includes features to maintain the sessions also during this handover between two quite different access technologies.

As another example, "You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi."[5]

> Think of this as a use case: you carry a device that can access, among other technologies, LTE and WiFi. You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi. The EPS network then includes features to maintain the sessions also during this handover between two quite different access technologies.[6]

T-Mobile provides, directs, controls, and manages the foregoing instrumentalities.

> These T&Cs are an agreement between you an us, T-Mobile USA, Inc., and our controlled subsidiaries, assignees, and agents.
>
> Any equipment for which we provide Service or which we provide to you to be used with our Service, such as a phone, handset, tablet, SIM card, or accessory (collectively, a "Device");

. . .

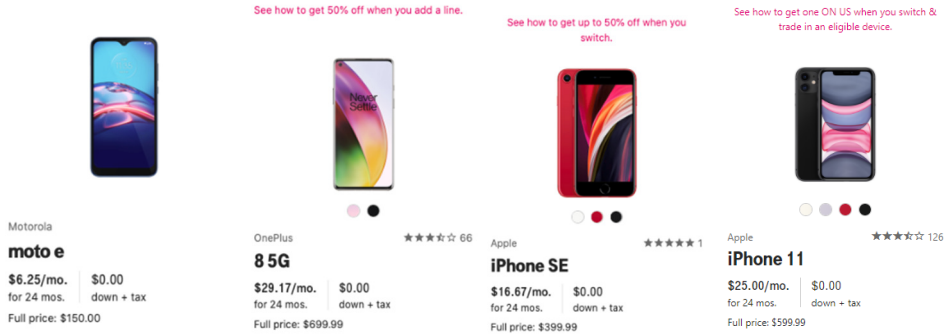
Our wireless network is a shared resource, which we manage for the benefit of all of our customers. Your Data Plan is intended for Web browsing, messaging, and similar activities. Certain activities and uses of our Services and your Device are permitted and others are not. If you buy, lease, or finance a Device manufactured for use on our network, you agree, and we rely on your agreement, that you intend it to be activated on our Service and will not resell or modify the Device, or assist anyone doing so.

Unless explicitly permitted by your Rate Plan or Data Plan, you are not permitted to use your Device or the Services in a way that we determine:

- Compromises network security or capacity, degrades network performance, uses malicious software or "malware", hinders other customers' access to the network, or otherwise adversely impacts network service levels or legitimate data flows;
- Uses applications which automatically consume unreasonable amounts of available network capacity;
- Uses applications which are designed for unattended use, automatic data feeds, automated machine-to-machine connections, or applications that are used in a way that degrades network capacity or functionality;
- Misuses the Service, including "spamming" or sending abusive, unsolicited, or other mass automated communications;
- Accesses the accounts of others without authority;
- Results in more than 50% of your voice and/or data usage being Off-Net (i.e., connected to another provider's network) for any 2 billing cycles within any 12-month period;
- Results in unusually high usage (specifically, more 50GB (updated periodically) in a month) and the majority of your data usage being Smartphone Mobile HotSpot (tethering) usage for any 3 billing cycles within any 6-month period;
- Resells the Service, either alone or as part of any other good or service;[7]

	Additionally and/or in the alternative, T-Mobile's system/service also includes configurations providing voice/data communications network connecting and roaming for streaming and browsing apps, including via T-Mobile and third-party apps. For example, T-Mobile also provides roaming of voice/data signals, such as media streaming through Binge On, which enables on demand streaming on T-Mobile Wireless, with "seamless" switching between networks.[8] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[9] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[10] It is anticipated that discovery will provide further details of the manner of infringement of the Accused Instrumentalities. Upon information and belief, KAIFI contends that these infringement contentions are equally applicable to all examples, aspects, applications, configurations, embodiments, and instances of T-Mobile's voice/data communications network connecting and roaming system and service, including but not limited to T-Mobile's Wi-Fi Calling and IP multimedia services. For example, these contentions are equally applicable to T-Mobile's Wi-Fi Calling as they are to T-Home Internet (including its LTE and 5G networks), T-Mobile Wi-Fi Services (including Wi-Fi hotspots), T-Vision, Binge On, Music Freedom, and any and all "over the top" media streaming services and IP Multimedia Subsystem services.

a data communication terminal that includes an indoor wireless connection module and stores registered indoor system ID information, so that the data communication terminal may be connected with the indoor network if the registered indoor system ID information is received and by connecting with the outdoor wireless internet network if the registered indoor system ID information is not received;	The Accused Instrumentalities provide a data communication terminal that includes an indoor wireless connection module and stores registered indoor system ID information, so that the data communication terminal may be connected with the indoor network if the registered indoor system ID information is received and by connecting with the outdoor wireless internet network if the registered indoor system ID information is not received.
	
	For example, T-Mobile's Wi-Fi Calling system and service comprise a data communication terminal, a phone that supports Wi-Fi Calling.[11]
	
	• **Phone that supports T-Mobile Wi-Fi Calling:**
	  • Wi-Fi Calling is included on most T-Mobile devices. Check the **Devices** page to look up your phone.
	  • Some manufacturers state their devices have T-Mobile Wi-Fi Calling. Most of these devices work without any problems, but T-Mobile **cannot** guarantee their service unless you bought the device from us.
	
	Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[12]



An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[13]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

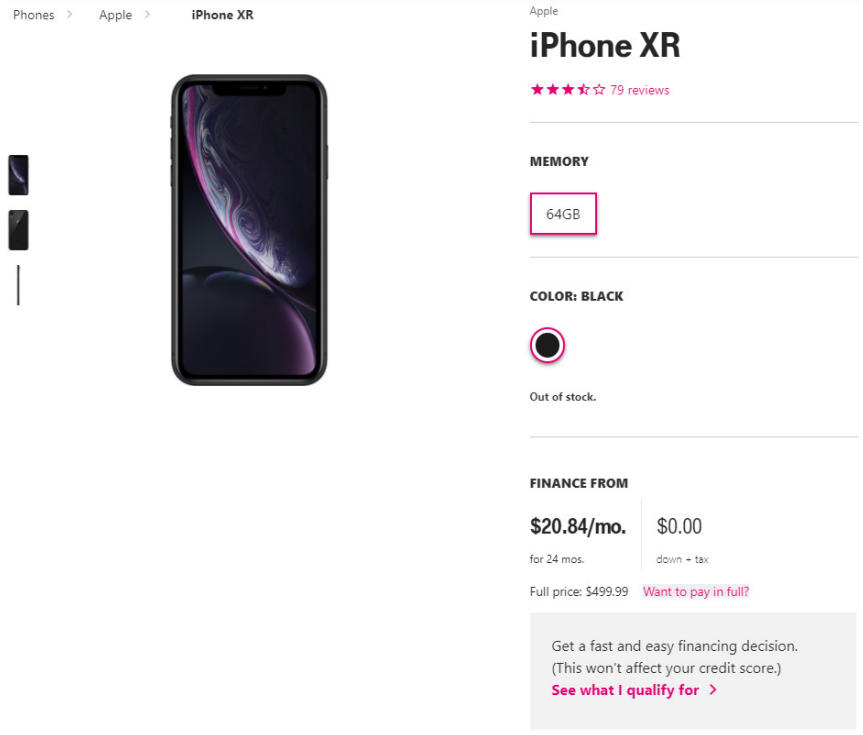
This device includes an "indoor" wireless connection module and stores registered indoor system ID information.[14]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

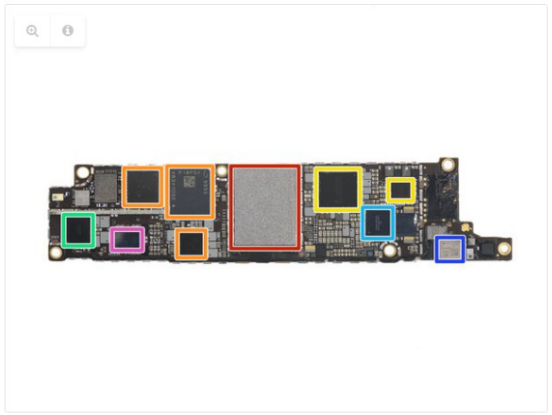
The Apple iPhone XR wireless data communication terminal includes a Wi-Fi modem indoor wireless connection module.[15]

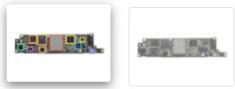


Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

Step 8





- More chips on the back side of the logic board. Show us your identification, please...
  - Toshiba TSB3243VC0428CHNA1 64 GB flash storage
  - Intel 9955 (likely the XMM7560 LTE Advanced Pro 4G LTE baseband processor), 5762 RF transceiver, and 5829
  - Apple 338S00383-A0, 338S00375-A1 power management IC's (possibly from Dialog Systems)
  - Texas Instruments SN2600B1 battery charging IC
  - Apple 338S00248 audio codec (possibly from Cirrus Logic)
  - Skyworks 13768 front end module
  - Broadcom 59355A2IUB4G (likely a variation of the BCM59350 wireless power receiver chip)

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[16]

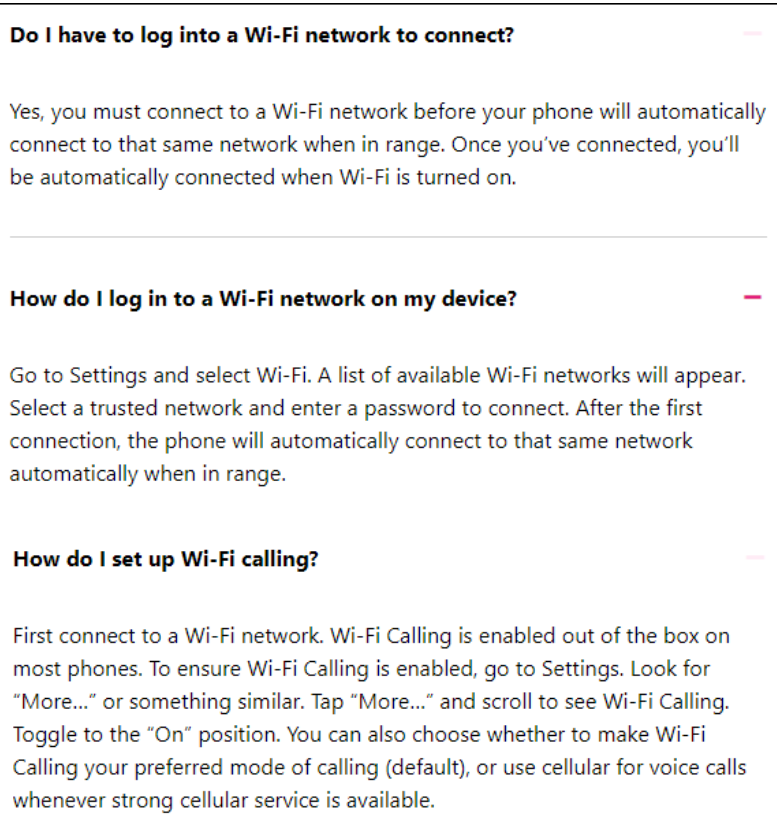
How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The Apple iPhone stores this information so that it may be connected with the indoor network if the registered indoor system ID information is received and by connecting with the outdoor wireless internet network if the registered indoor system ID information is not received.[17]



Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

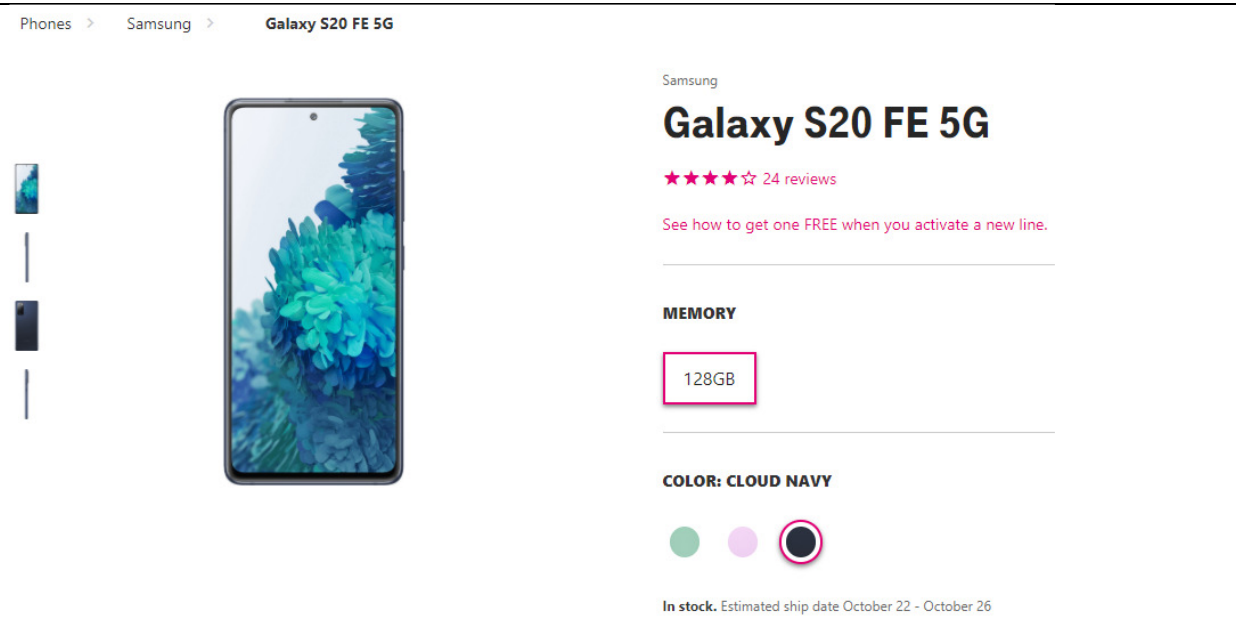
How do I log in to a Wi-Fi network on my device?

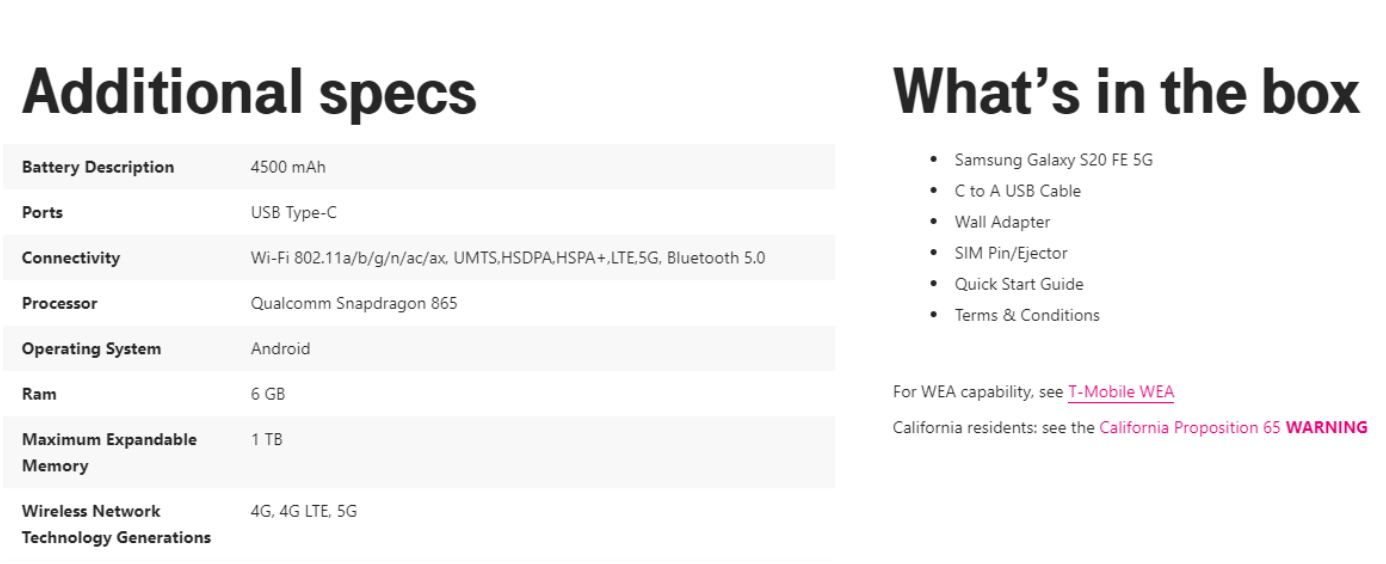
Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

How do I set up Wi-Fi calling?

First connect to a Wi-Fi network. Wi-Fi Calling is enabled out of the box on most phones. To ensure Wi-Fi Calling is enabled, go to Settings. Look for "More..." or something similar. Tap "More..." and scroll to see Wi-Fi Calling. Toggle to the "On" position. You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 System on Chip ("SoC").[18]





The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[19]

	Qualcomm® FastConnect™ Subsystem	**Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time
	Cellular Modem	**Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system
	Cellular Technology	**Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support
	Wi-Fi	**Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency

The data communication terminals store registered indoor system ID information, such as a Wi-Fi network SSID.[20] The terminals connect with an indoor network, such as a home or office Wireless LAN or Wi-Fi network, if the registered indoor system ID information is received.[21] For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[22]

If the registered indoor system ID information is not received, the terminal connects with the outdoor wireless internet network, such as T-Mobile's cellular telephony system and service. For example, "[t]he primary

	responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[23] "The platform will ultimately decide on which network the device connects to."[24] T-Mobile sells data communication terminals that support both cellular and Wi-Fi calling, including but not limited to:[25] Alcatel Go Flip 3; Joy Tab; Joy Tab Kids; Apple iPhone 12 Pro; iPhone 12; iPhone SE; iPhone 11; iPhone 11 Pro; iPhone 11 Pro Max; iPhone XR; iPad Air; iPad 8th gen; iPad Pro 11-inch 2nd gen; iPad Pro 12.9-inch 4th gen; iPad 7th gen; iPad Air 3rd gen; iPad mini; Motorola razr 5G; moto e; OnePlus 8T+ 5G; 8 5G; Samsung Galaxy S20 FE 5G; Note20 Ultra 5G; Z Fold2 5G; Note20 5G; A71 5G; A51 5G; S20 Ultra 5G; Z Flip 5G; A21; A11; A10e; S20 5G; S20+ 5G; Galaxy Tab S7 5G; Galaxy Tab S7+ 5G; Galaxy Tab A 8.4; and T-Mobile REVVL 5G; REVVL 4+; REVVL 4. It is anticipated that discovery will provide further details regarding data communication terminals used, sold, offered, and/or provided by T-Mobile, including any alternative configurations and any corresponding structures in the Accused Instrumentalities. Each data communication terminal referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor wireless connection module," "indoor system ID information," "indoor network, or "outdoor wireless internet network," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents.

an indoor gateway that includes an indoor wireless connection module therein, broadcasts the indoor system ID information, makes wireless communications with the data communication terminal through the indoor wireless connection module, and is connected with the internet network via a wire;	The Accused Instrumentalities provide an indoor gateway that includes an indoor wireless connection module therein, broadcasts the indoor system ID information, makes wireless communications with the data communication terminal through the indoor wireless connection module, and is connected with the internet network via a wire. As one example, the Accused Instrumentality comprises an indoor gateway. An indoor gateway is a wireless access point or node for connecting to a LAN and the internet with a wire, such as a home or business gateway, router, "hotspot," mesh-network node, or ad hoc network node. A Wi-Fi access point broadcasts indoor system ID information (*e.g.*, network SSID), and makes wireless communications with the data communication terminal through the indoor wireless connection module.[26] **What is an Access Point?** An access point is a device that creates a wireless local area network, or WLAN, usually in an office or large building. An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area. For example, if you want to enable Wi-Fi access in your company's reception area but don't have a router within range, you can install an access point near the front desk and run an Ethernet cable through the ceiling back to the server room. The Wi-Fi Calling system and service can be used with "any available Wi-Fi connection."[27] For example, Defendants provide a Wi-Fi Gateway and access to a network of nationwide Wi-Fi hotspots.[28] **What is T-Mobile Home Internet?** T-Mobile Home Internet is a new offering from T-Mobile, available at certain addresses in limited areas. It's fast, affordable home internet service that lets you do it all for just $50 a month with AutoPay. T-Mobile Home Internet service connects to the same great LTE network T-Mobile smartphones run on. You receive service through an LTE Wi-Fi Gateway device (which combines the capabilities of a router and a modem), converts the LTE signal to Wi-Fi, and provides a Wi-Fi signal accessible by all the devices in your home. You'll also get T-Mobile's amazing customer support to answer all your questions! Furthermore, T-Mobile's Home Internet "is designed for use in your house and should be perminantely placed in the best possible location to pick up the LTE signal."[29] T-Mobile provides an indoor gateway, e.g., LTE Wi-Fi Gateway (TM-RTL0102), and Wi-Fi CellSpot Router (T-Mobile AC-1900), to its customers.[30] Furthermore, T-Mobile's indoor gateways may be connected to the internet via a wire, *see, e.g.,* T-Mobile's CellSpot "[r]equires a wired high-speed internet connection" and "[o]n the back the CellSpot has … one Gigabit WAN port (to connect to an Internet source, such as a broadband modem)"[31]

How do I set up T-Mobile Home Internet?

Simply power up your LTE Wi-Fi Gateway, download the T-Mobile Home Internet app (Android or iOS), and follow a few instructions. And if you have any trouble, you can contact our T-Mobile Home Internet support team through the app or at 1-844-275-9310 for 24x7 assistance.

T-Mobile provides Wi-Fi hotspots (for internet).[32]

T-Mobile provides Wi-Fi hotspots through Boingo Wireless ("Boingo"), "the Wi-Fi industry's leading nationwide provider of software and services."

> With the new agreement, T-Mobile Hotspot and postpaid mobile broadband subscribers will now have Wi-Fi access at no additional charge at 53 Boingo airport locations in the United States and Canada, including major airports in the New York and Chicago metropolitan areas. The expanded agreement also includes the Washington State Ferries in the Seattle area.
>
> Similarly, Boingo subscribers will have continued Wi-Fi access at T-Mobile Hotspot airport locations and expanded access at T-Mobile HotSpot airline club and hotel locations, including the airline clubs of American Airlines, United Airlines, US Airways and Delta Airlines and Hyatt hotels.
>
> "Expanding our agreement with T-Mobile USA reinforces our commitment to delivering customers seamless Wi-Fi access to a larger, collective footprint," said Colby Goff, senior vice president of strategy for Boingo Wireless. "We pride ourselves in listening to our customers and giving them access to Wi-Fi when and where they need it. Boingo users can now enjoy connectivity at airport lounges – a top request – and we welcome T-Mobile subscribers to our airport and ferry networks."[33]

T-Mobile also provides Wi-Fi hotspot devices, including but not limited to: T9 Mobile Hotspot and Linkzone 2.[34]

T-Mobile provides Home Internet and Wi-Fi Services:[35]

Are there ways I can't use Home Internet?

You can use your Home Internet for all the homework, streaming, and video conferencing you need! But to ensure that our network is available for all customers, there are some restrictions on activities that can damage or disproportionately congest the network. For example, Home Internet is not intended for unattended use, automatic data feeds, automated machine-to-machine connections, or uses that automatically consume unreasonable amounts of available network capacity. Please see T-Mobile's Terms and Conditions for prohibited uses.

> T-Mobile and Sprint are now part of the same family. While T-Mobile is working to build a combined network, the Sprint network continues to operate. Sprint customers' traffic may be carried in some areas by the T-Mobile network (e.g. where T-Mobile's network is available and

Sprint's is not). These Sprint customers will continue to experience the network management practices disclosed on Sprint's Open Internet page, but while on the T-Mobile network can expect to experience the speeds and data prioritization disclosed on this page.

...

Broadband Internet Access Services are subject to the T-Mobile Terms and Conditions at https://www.t-mobile.com/responsibility/legal/terms-and-conditions. Specific information about our Broadband Internet Access Services can be found under the heading "Using Our Network" Certain uses of our network are also prohibited as described in our Terms and Conditions under the heading "Examples of Permitted and Prohibited Uses of the Services and Your Device." E-Rate and other government or enterprise customers' use of T-Mobile's Broadband Internet Access Services may also be governed by an applicable government contract or Major Account Agreement.[36]

Our wireless network is a shared resource, which we manage for the benefit of all of our customers. Your Data Plan is intended for Web browsing, messaging, and similar activities. Certain activities and uses of our Services and your Device are permitted and others are not. If you buy, lease, or finance a Device manufactured for use on our network, you agree, and we rely on your agreement, that you intend it to be activated on our Service and will not resell or modify the Device, or assist anyone doing so. Here are examples of permitted and prohibited uses.

Permitted uses include:

- Voice calls;
- Web browsing;
- Messaging;
- Email;
- Streaming music;
- Uploading and downloading applications and content to and from the Internet or third party stores;
- Using applications and content without excessively contributing to network congestion;

	and • Tethering your Device to other non-harmful devices pursuant to the terms and conditions and allotments of your Data Plan.[37] It is anticipated that discovery will provide further details regarding indoor gateways used, sold, offered, and/or provided by T-Mobile, including commercial gateway hardware, alternative configurations, and any corresponding structures in the Accused Instrumentalities. Each indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor gateway," "indoor wireless connection module," or "indoor system ID information," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents.
a location register that stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network; and	The Accused Instrumentalities provide a location register that stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network. The Accused Instrumentality comprises a location register that stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network. For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[38]

5G

- Frequencies that can provide 5G:
  - **Band n71** (600 MHz)
  - **Band n41** (2.5 GHz)
  - **Band n260** (39 GHz)
  - **Band n261** (28 GHz)
- With 5G, high amounts of data can be transmitted more efficiently than 4G LTE.
- One of the ways T-Mobile is rapidly deploying 5G is integrating mid-band 2.5 GHz spectrum from Sprint.
- Check out **What is 5G?** to learn how it works!

Extended Range 4G LTE

- Frequencies that can provide Extended Range LTE
  - **Band 12** (700 MHz)
  - **Band 71** (600 MHz)
- Our Extended Range LTE signal reaches 2X as far and penetrates walls for 4X better coverage in-buildings than ever before.

4G LTE

- Frequencies that can provide LTE:
  - **Band 2** (1900 MHz)
  - **Band 5** (850 MHz)
  - **Band 4** (1700/2100 MHz)
  - **Band 66** (Extension of band 4 on 1700/2100 MHz).
- 4G LTE offers fast download speeds, up to 50% faster speeds than 3G. See **Data speeds**.
- Voice and data services only work at the same time when on you have VoLTE enabled on your device. Otherwise, LTE only provides data.

- VoLTE ("Voice over LTE") ⊕

The 4G LTE Network uses the 3GPP Evolved Packet Core ("EPC") and Evolved UMTS Terrestrial Radio Access Network ("E-UTRAN"). The EPC/E-UTRAN architecture is designed to allow interworking between different access technologies and, in particular LTE and Wi-Fi. In this network architecture, an entity called the Home Subscriber Server ("HSS") acts as a common database for all subscriber data.[39]

The HSS "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[40]

Within the EPC, the HSS connects via SWx interface to a logical node called the 3GPP Authentication, Authorization, and Accounting ("AAA") Server, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[41]

The 3GPP standard illustrates this.[42]

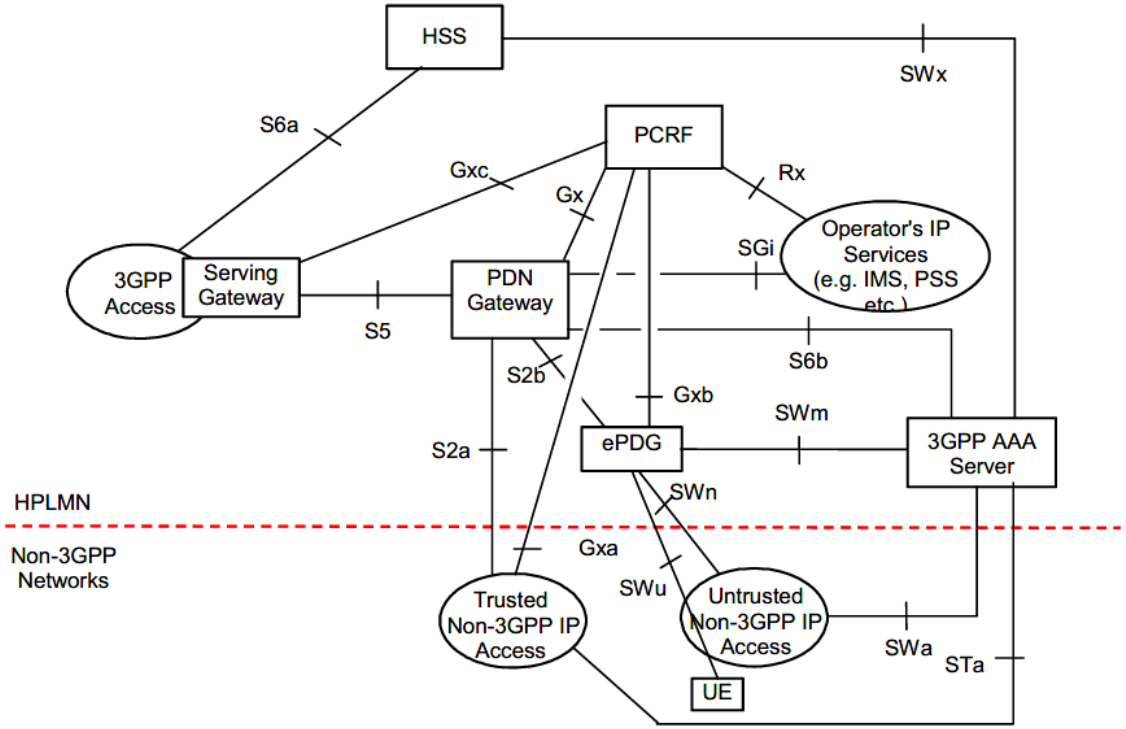


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

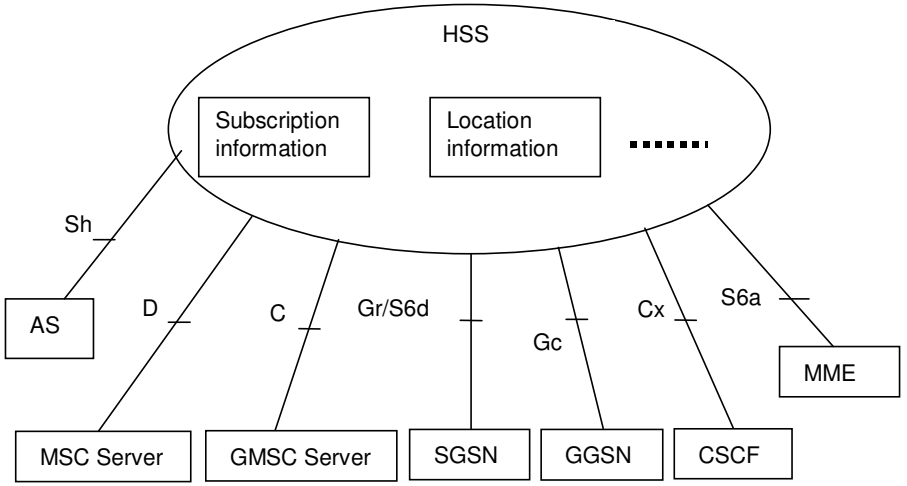
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[43]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the Packet Data Network Gateway ("PDN GW") over the S6b interface; the Evolved Packet Data Gateway ("ePDG") over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor).[44]

The Gateway Mobile Location Center ("GMLC") is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[45] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[46]



The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for Evolved Packet System ("EPS") 3GPP access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[47]

As another example, the HSS stores the "subscribed QoS profile."[48]

In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[49]

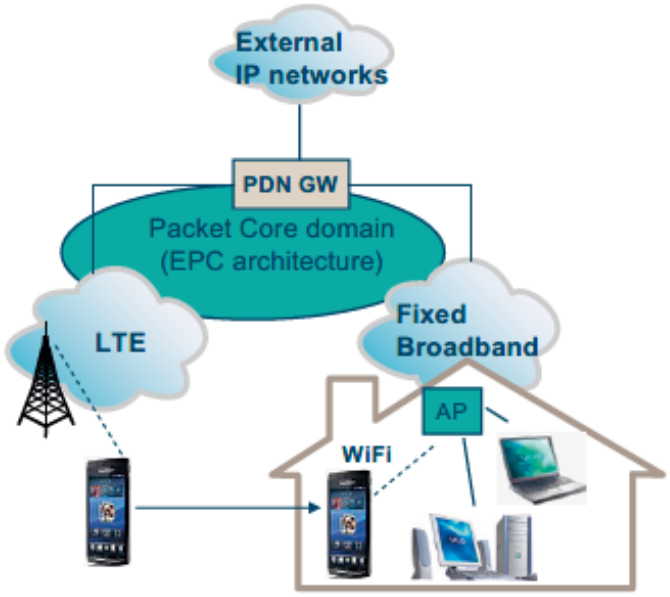
A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[50]

An APN is the label for the Wi-Fi access point.[51]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[52] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[53]

As another example, various forms of location information are provided by the Accused Instrumentalities, including but not limited to Cell Identification ("CID") and Time Difference of Arrival ("TDOA"). Such location information is utilized in relation with various aspects of the Accused Instrumentalities, including but

	not limited to an Enhanced Serving Mobile Location Center ("E-SMLC"), Mobility Management Entity ("MME"), and Gateway Mobile Location Center ("GMLC").[54] Additionally and/or in the alternative, T-Mobile's LTE network comprises a Binding Cache Entry ("BCE"), flow binding information, and/or IP flow information.[55] Additionally and/or in the alternative, T-Mobile's LTE network comprises a Local Mobility Anchor ("LMA") and/or Home Agent ("HA").[56] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[57] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[58] It is anticipated that discovery will provide further details regarding location registers used, sold, offered, and/or provided by T-Mobile, including any alternative configurations and including in the alternative any corresponding structures in the data communication terminals. Each location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise a "location register," "indoor network" or "outdoor wireless internet network," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents.

a router that determines the location of the data communication terminal stored in the location register and provides roaming of voice/data signals provided to the user by selecting one of the indoor and the outdoor networks in accordance with the determined location of the data communication terminal.	The Accused Instrumentalities provide a router that determines the location of the data communication terminal stored in the location register and provides roaming of voice/data signals provided to the user by selecting one of the indoor and the outdoor networks in accordance with the determined location of the data communication terminal. The Accused Instrumentality comprises a router that determines the location of the data communication terminal stored in the location register and provides roaming of voice/data signals provided to the user by selecting one of the indoor and the outdoor networks in accordance with the determined location of the data communication terminal. For example, the Accused Instrumentality "seamlessly" transitions the voice or data signal from the outdoor 4G LTE cellular network to the Wi-Fi network to "[e]xtend[] coverage in areas where no cellular network reaches."[59] And "when the device is in range of a reliable Wi-Fi network, Wi-Fi calls and cellular calls are similar in quality. In fact, T-Mobile is the only major national carrier to offer HD Voice on Wi-Fi, and VoLTE for crystal clear HD Voice quality."[60] Furthermore, "T-Mobile is pioneering a seamless handover between our LTE network and any available Wi-Fi connection so calls don't drop between the two."[61] For example, Defendants' 4G LTE Network includes a Packet Data Network Gateway, "PDN GW" or "P-GW."[62]  **Figure 2.16: Interworking Between 3GPP Access and Non-3GPP Access Technologies.**

This is further illustrated by the 3GPP standards.[63]

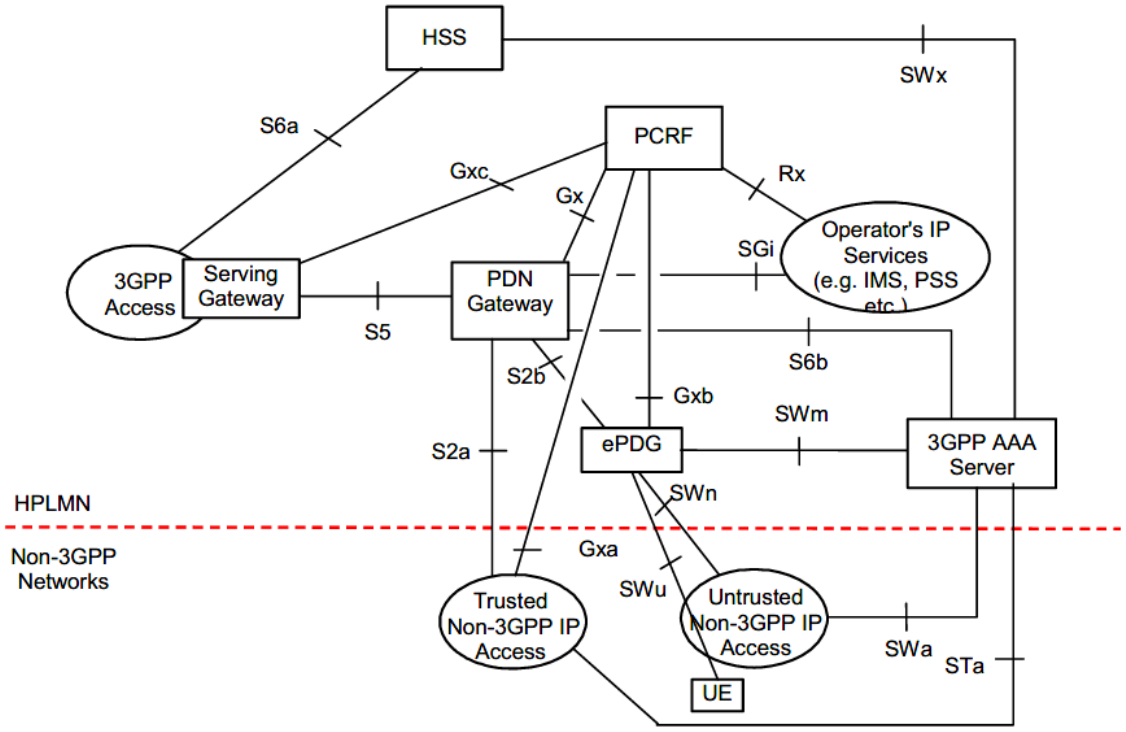


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

The PDN GW is the point of interconnect between the EPC and external IP networks. IP traffic runs through the PDN GW. The PDN GW interfaces the 3GPP AAA Server to retrieve subscriber data stored in the HSS, including location information stored in the location register.[64]

The PDN GW routes packets to and from the various packet data networks.[65]

The PDN GW provides roaming for voice and data signals to the user by selecting the LTE (outdoor) network or Wi-Fi (indoor) network in accordance with the location of the data communication terminal.[66]

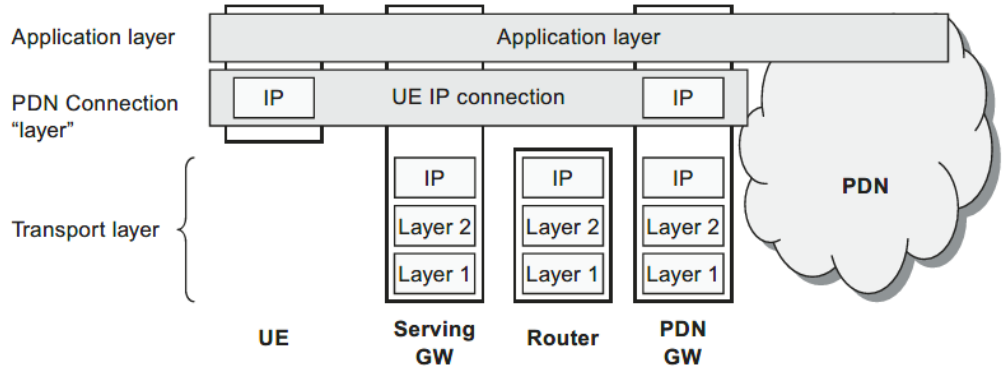


Figure 6.3: Schematic View of Application, PDN Connection, and Transport Layers for 3GPP Family of Accesses.

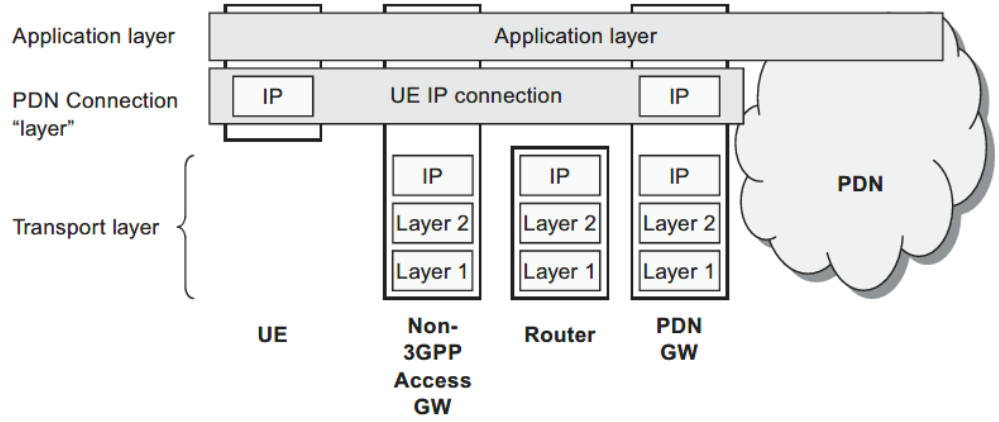


Figure 6.4: Schematic View of Application, PDN Connection, and Transport Layers for Trusted Non-3GPP Accesses When PMIP or GTP Is Used on S2a.

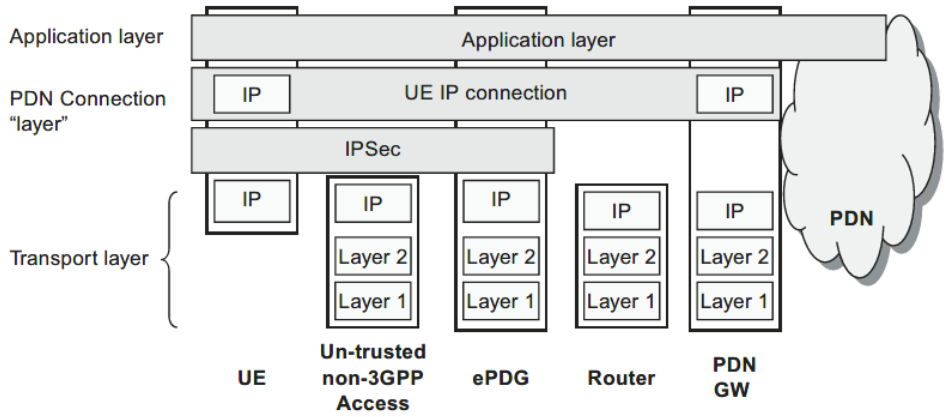


Figure 6.5: Schematic View of Application, PDN Connection, and Transport Layers for Untrusted Non-3GPP Accesses When PMIP or GTP Is Used on S2b.

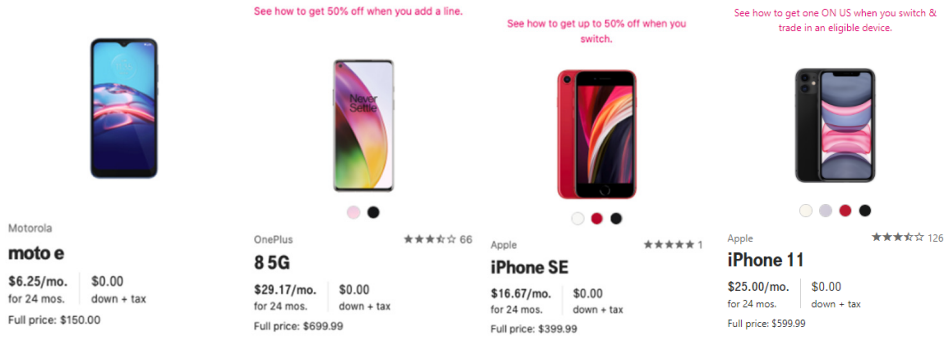
Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[67]

The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[68]

It is anticipated that discovery will provide further details regarding routers used, sold, offered, and/or provided by T-Mobile, including any alternative configurations and any corresponding structures in the Accused Instrumentalities.

Each router referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise a "router," "indoor network" or "outdoor network," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents.

2. The internet network connecting and roaming system according to claim 1, wherein the data communication terminal compares the received indoor system ID information with the stored indoor system ID information, and sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the data communication terminal compares the received indoor system ID information with the stored indoor system ID information, and sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information. For example, the Accused Instrumentality comprises an internet network connecting and roaming system according to claim 1, as discussed above, wherein the data communication terminal compares the received indoor system ID information with stored indoor system ID information. The data communication terminal in the Accused Instrumentalities sets its own mode to one of an indoor communication mode and an outdoor communication mode, depending on whether the received indoor system ID information is equal to the stored indoor system ID information. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[69]  An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[70]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

This device includes an indoor wireless connection module, such as a Wi-Fi chip, and stores registered indoor system ID information.[71]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

This device compares received indoor system ID information with the stored indoor system ID information.

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[72]

How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

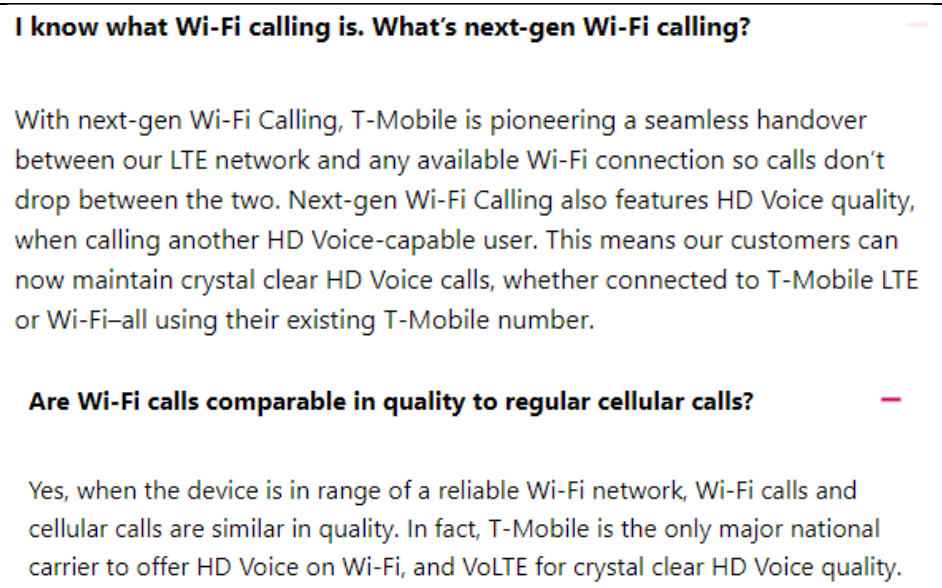
1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The device sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information.[73]

What are the unique benefits of Wi-Fi calling?

Where do we start? Benefits include:

- Integrated out-of-the-box experience on T-Mobile capable devices – no extra app necessary
- Uses your existing phone number – no additional logins necessary
- Call or message virtually anyone from anywhere you have a Wi-Fi connection
- Extends coverage in areas where no cellular network reaches
- Receive and make Wi-Fi calls back to the United States from anywhere in the world at no additional cost
- Available at no additional charge



I know what Wi-Fi calling is. What's next-gen Wi-Fi calling?

With next-gen Wi-Fi Calling, T-Mobile is pioneering a seamless handover between our LTE network and any available Wi-Fi connection so calls don't drop between the two. Next-gen Wi-Fi Calling also features HD Voice quality, when calling another HD Voice-capable user. This means our customers can now maintain crystal clear HD Voice calls, whether connected to T-Mobile LTE or Wi-Fi–all using their existing T-Mobile number.

Are Wi-Fi calls comparable in quality to regular cellular calls?

Yes, when the device is in range of a reliable Wi-Fi network, Wi-Fi calls and cellular calls are similar in quality. In fact, T-Mobile is the only major national carrier to offer HD Voice on Wi-Fi, and VoLTE for crystal clear HD Voice quality.

For example, when the device is connected to Wi-Fi, the Wi-Fi Calling feature is enabled on the device, and a cellular connection is unavailable or poor, calls will be carried over Wi-Fi as indicated by a "Wi-Fi Calling icon."[74]

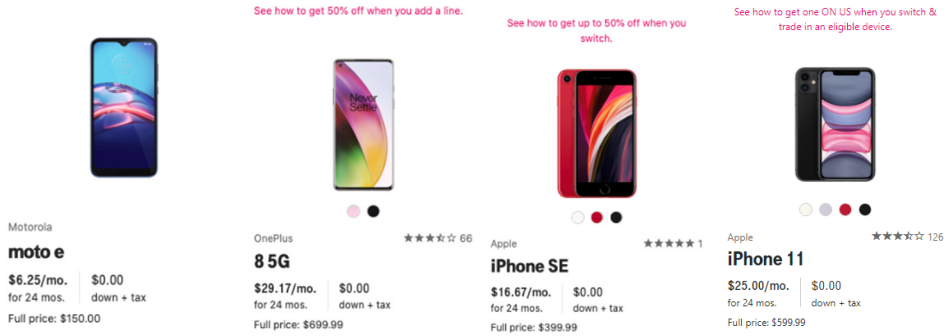
As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC,[75] which includes a Wi-Fi modem indoor wireless connection module.[76] The device stores registered indoor system ID information, such as a Wi-Fi network SSIDs.[77]

This device compares received indoor system ID information with the stored indoor system ID information. For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[78]

The device sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information. For example, "[t]he primary responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[79] "The platform will ultimately decide on which network the device connects to."[80]

It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities.

Each data communication terminal referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

	To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor system ID information," "indoor communication mode," or "outdoor communication mode," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4.
3. The internet network connecting and roaming system according to claim 1, wherein one or more items of the indoor system ID information are registered in the data communication terminal.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein one or more items of the indoor system ID information are registered in the data communication terminal. For example, the Accused Instrumentality comprises an internet network connecting and roaming system according to claim 1, as discussed above, wherein one or more items of the indoor system ID information are registered in the data communication terminal. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[81] 

An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[82]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

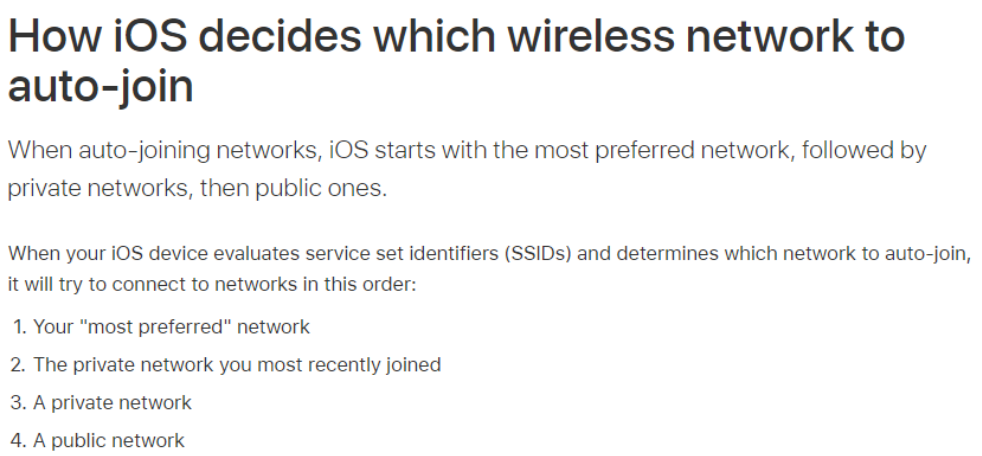
One or more items of the indoor system ID information are registered in the data communication terminal.[83]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[84]



How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

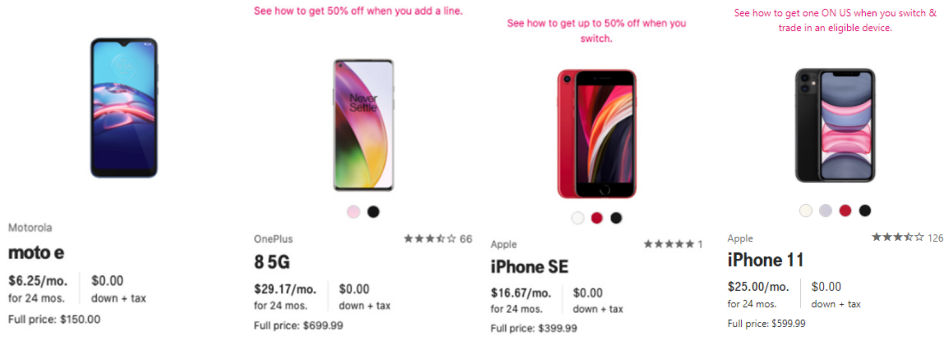
1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC and 128 GB of internal memory storage.[85] The device stores registered indoor system ID information, such as a Wi-Fi network SSIDs.[86]

It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities.

Each data communication terminal referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

See also discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4.

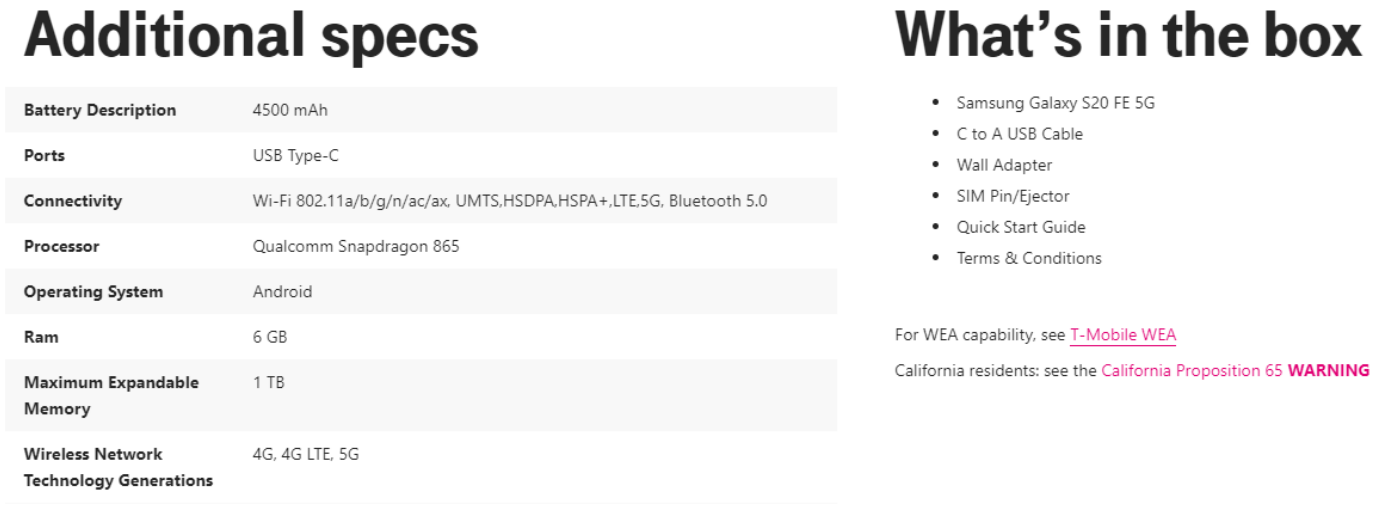
4. The internet network connecting and roaming system according to claim 1, wherein the data communication terminal informs the location register that the terminal is located indoors by registering its location into the location register using a mobile IP if the registered indoor system ID information is received, and the data communication terminal informs the location register that the terminal is located outdoors by storing locational area information in the location register if the registered indoor system ID information is not received.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the data communication terminal informs the location register that the terminal is located indoors by registering its location into the location register using a mobile IP if the registered indoor system ID information is received, and the data communication terminal informs the location register that the terminal is located outdoors by storing locational area information in the location register if the registered indoor system ID information is not received. For example, the Accused Instrumentality comprises an internet network connecting and roaming system according to claim 1, as discussed above, wherein the data communication terminal informs the location register that the terminal is located indoors by registering its location into the location register using a mobile IP if the registered indoor system ID information is received, and the data communication terminal informs the location register that the terminal is located outdoors by storing locational area information in the location register if the registered indoor system ID information is not received. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[87]  An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[88]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[89]



Additional specs

Battery Description	4500 mAh
Ports	USB Type-C
Connectivity	Wi-Fi 802.11a/b/g/n/ac/ax, UMTS,HSDPA,HSPA+,LTE,5G, Bluetooth 5.0
Processor	Qualcomm Snapdragon 865
Operating System	Android
Ram	6 GB
Maximum Expandable Memory	1 TB
Wireless Network Technology Generations	4G, 4G LTE, 5G

What's in the box

- Samsung Galaxy S20 FE 5G
- C to A USB Cable
- Wall Adapter
- SIM Pin/Ejector
- Quick Start Guide
- Terms & Conditions

For WEA capability, see T-Mobile WEA

California residents: see the California Proposition 65 **WARNING**

The data communication terminal informs the location register that the terminal is located indoors by registering its location into the location register using a mobile IP if the registered indoor system ID information is received.

The data communication terminal informs the location register that the terminal is located outdoors by registering its locational area information in the location register if the registered indoor system ID information is not received.

For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[90]

5G

- Frequencies that can provide 5G:
  - **Band n71** (600 MHz)
  - **Band n41** (2.5 GHz)
  - **Band n260** (39 GHz)
  - **Band n261** (28 GHz)
- With 5G, high amounts of data can be transmitted more efficiently than 4G LTE.
- One of the ways T-Mobile is rapidly deploying 5G is integrating mid-band 2.5 GHz spectrum from Sprint.
- Check out **What is 5G?** to learn how it works!

Extended Range 4G LTE

- Frequencies that can provide Extended Range LTE
  - **Band 12** (700 MHz)
  - **Band 71** (600 MHz)
- Our Extended Range LTE signal reaches 2X as far and penetrates walls for 4X better coverage in-buildings than ever before.

4G LTE

- Frequencies that can provide LTE:
  - **Band 2** (1900 MHz)
  - **Band 5** (850 MHz)
  - **Band 4** (1700/2100 MHz)
  - **Band 66** (Extension of band 4 on 1700/2100 MHz).
- 4G LTE offers fast download speeds, up to 50% faster speeds than 3G. See **Data speeds**.
- Voice and data services only work at the same time when on you have VoLTE enabled on your device. Otherwise, LTE only provides data.

- VoLTE ("Voice over LTE") ⊕

The 4G LTE Network uses the 3GPP EPC (Evolved Packet Core) and E-UTRAN (Evolved UMTS Terrestrial Radio Access Network). The EPC/E-UTRAN architecture is designed to allow interworking between different access technologies and, in particular LTE and Wi-Fi. In this network architecture, the HSS (Home Subscriber Server) acts as a common database for all subscriber data.[91]

The HSS "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[92]

Within the EPC, the HSS connects over the SWx interface to the 3GPP AAA Server logical node, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[93]

The 3GPP standard illustrates this.[94]

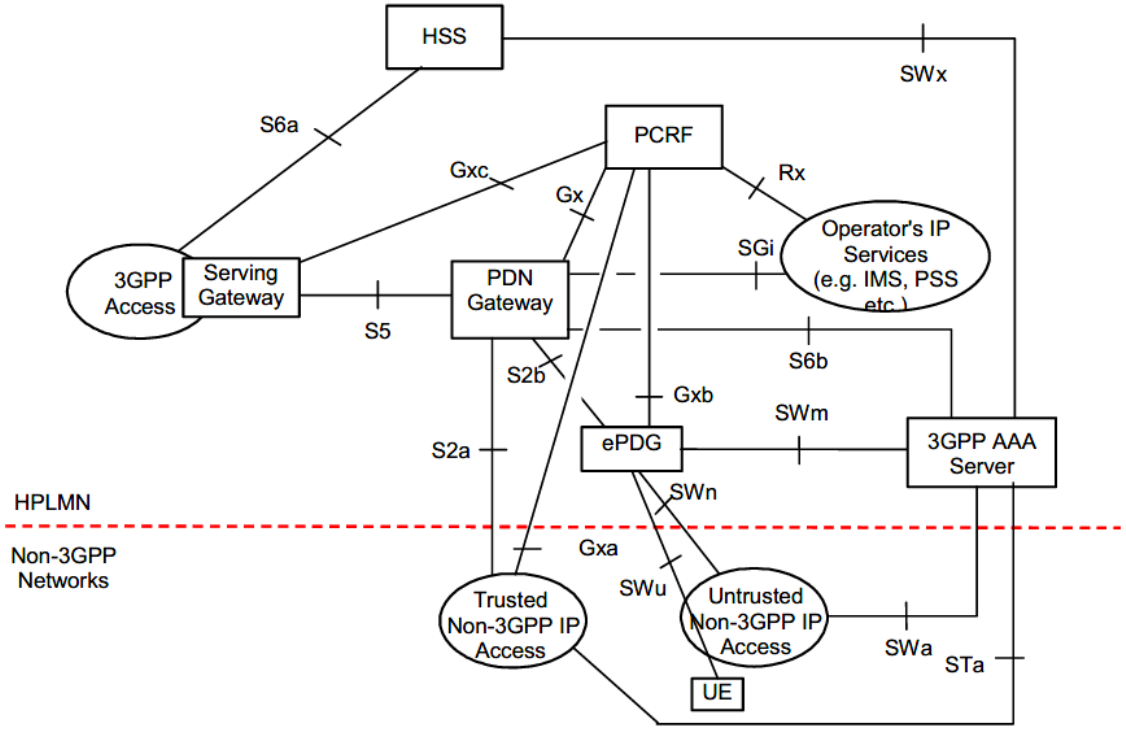


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

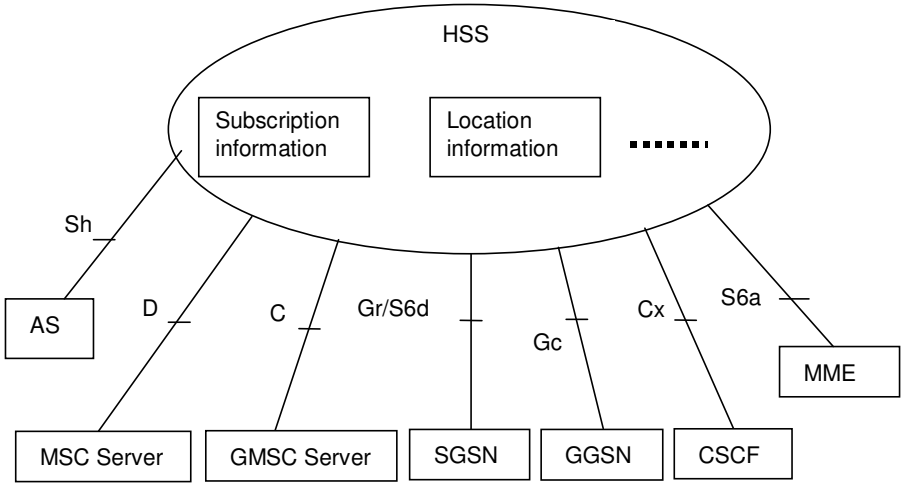
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[95]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN-Gateway (Packet Data Network Gateway) over the S6b interface; the ePDG (Evolved Packet Data Gateway) over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor). [96]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[97] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[98]



The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for 3GPP EPS (Evolved Packet System) access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[99]

As another example, the HSS stores the "subscribed QoS profile."[100]

In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[101]

A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[102]

An APN is the label for the Wi-Fi access point.[103]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[104] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[105]

As another example, various forms of location information are provided by the Accused Instrumentalities, including but not limited to CID (Cell Identification) and TDOA (Time Difference of Arrival). Such location information is utilized in relation with various aspects of the Accused Instrumentalities, including but not limited to an E-SMLC (Enhanced Serving Mobile Location Center), MME (Mobility Management Entity),

	and GMLC (Gateway Mobile Location Center).[106] As yet another example, this information can be registered using Mobile IP.[107] Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[108] Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[109] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[110] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[111] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally meet these elements, Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and location register, *supra* page 16.

5. The internet network connecting and roaming system according to claim 4, wherein the data communication terminal switches its connection from the indoor network to the outdoor wireless internet network when it is registered into and authenticated by the location register that the location of the terminal registered into the location register has been changed from the indoors to the outdoors while making a call, or switches its connection from the outdoor wireless internet network to the indoor network when it is registered into and authenticated by the location register that the location of the terminal has been changed from the outdoors to the indoors.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 4, wherein the data communication terminal switches its connection from the indoor network to the outdoor wireless internet network when it is registered into and authenticated by the location register that the location of the terminal registered into the location register has been changed from the indoors to the outdoors while making a call, or switches its connection from the outdoor wireless internet network to the indoor network when it is registered into and authenticated by the location register that the location of the terminal has been changed from the outdoors to the indoors. For example, the Accused Instrumentality provides a data communication terminal which switches its connection from the indoor Wi-Fi network to the outdoor 4G LTE network, when the location register HSS and/or AAA of the 4G LTE EPC (Evolved Packet Core) and/or E-UTRAN (Evolved UMTS Terrestrial Radio Access Network) registers and authenticates that the registered location of the terminal has been changed. The HSS (Home Subscriber Server) "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[112] Within the EPC, the HSS connects via SWx interface to a logical 3GPP AAA server, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[113] As one example, Extensible Authentication Protocol ("EAP") is used by a 3GPP AAA server as provided by the Accused Instrumentalities such that a data communication terminal is registered and authenticated by the location register.[114] As another example, encrypted tunnels are established between a data communication terminal and the EPC using IPsec, which creates a logical association between each terminal and the network, whereby the terminal is registered and authenticated by the location register.[115] The 3GPP standard illustrates this.[116]

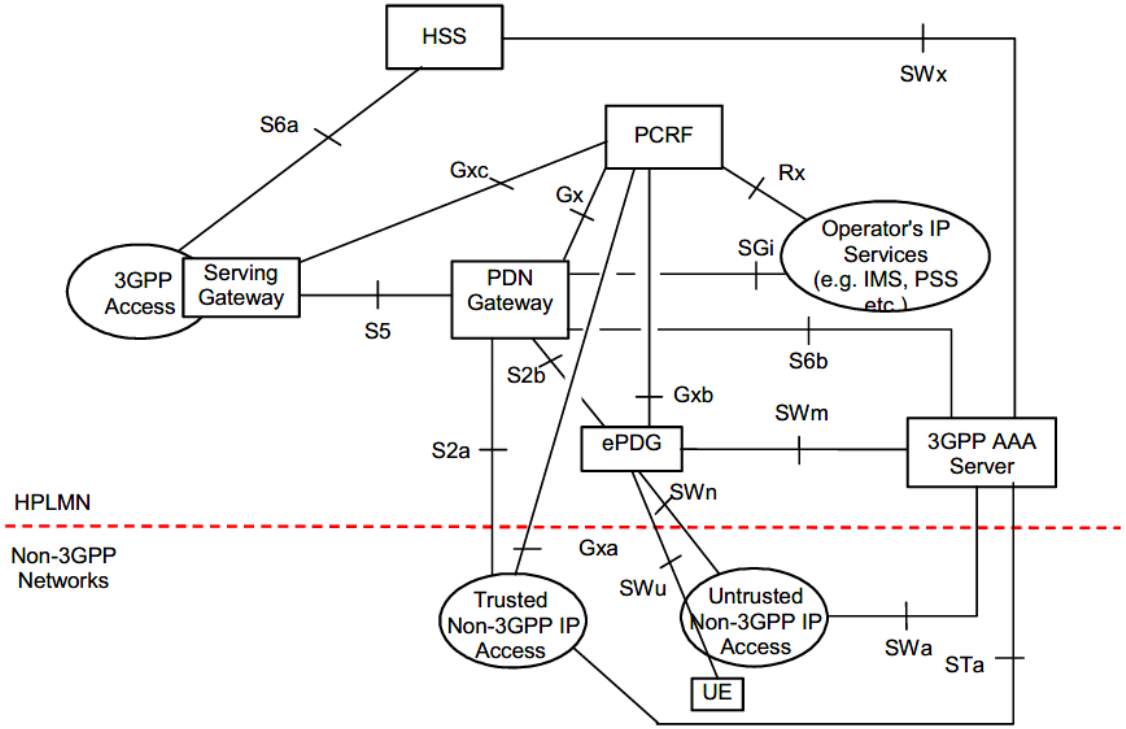


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

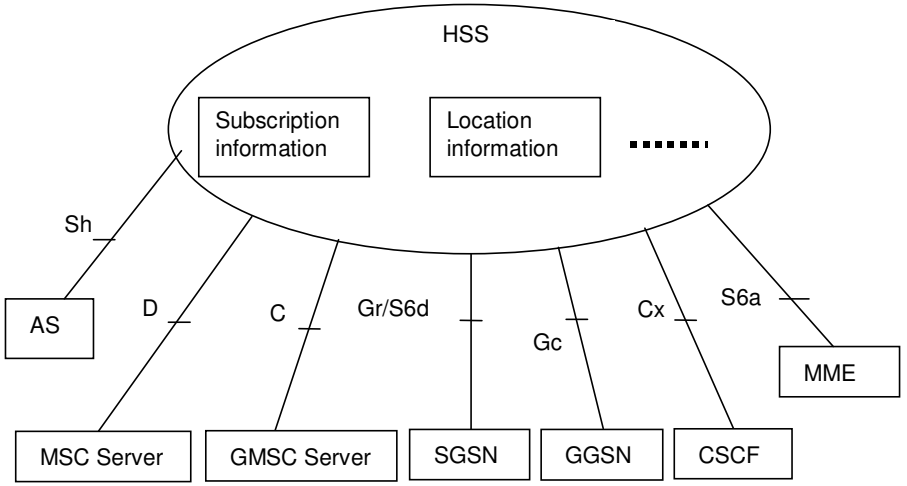
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[117]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN GW (Packet Data Network Gateway) over the S6b interface; the ePDG (Evolved Packet Data Gateway) over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor).[118]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[119] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[120]



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For example, the HSS stores a "PDN Address."[121]

As another example, the HSS stores the "subscribed QoS profile."[122]

In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[123]

A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[124]

An APN is the label for the Wi-Fi access point.[125]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[126] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[127]

Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[128]

	Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[129] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[130] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[131] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally meet these elements, Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 4, *supra* page 31; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and location register, *supra* page 16.
6. The internet network connecting and roaming system according to claim 1, wherein the location register is one of a home agent and a foreign agent.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the location register is one of a home agent and a foreign agent. For example, the Accused Instrumentality provides a home agent such as the PDN GW (Packet Data Network Gateway). "The PDN is the anchor point (mobile IP home agent) for 3GPP/non3GPP mobility situations. It is responsible for IP address allocation to the UE."[132] The Accused Instrumentalities also provide a foreign agent, defined as "a router on a visited network which provide[s] mobile IPv4 routing services to the UE while registered . . . ."[133] As explained above with regard to claim 1, the Accused Instrumentalities provide an indoor gateway.[134] T-Mobile provides Home Networking / Home Wi-Fi systems and services, as well as equipment, to its customers.[135] Additionally, the Accused Instrumentality can be used "anywhere [that the user has] a Wi-Fi connection."[136]

	"T-Mobile's LTE Wi-Fi Gateway uses the award winning T-Mobile network for your home Internet connection over Wi-Fi or ethernet."[137] Furthermore, the Accused Instrumentalities' use of a 3GPP HSS and/or AAA Server, which interfaces with logical entities in the EPC (including the PDN GW, the ePDG, Trusted Non-3GPP IP Access Networks, and Untrusted Non-3GPP IP Access Networks), aids in the Mobile IP home agent / foreign agent instance.[138] For example, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[139] A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[140] An APN is the label for the Wi-Fi access point.[141] Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[142] Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[143] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[144] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[145] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data connection terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the location register, *supra* page 16.
7. The internet network connecting and roaming system according to claim 1, wherein the indoor gateway is one of a home gateway and an IAD.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the indoor gateway is one of a home gateway and an IAD. For example, as described above with regard to claim 1, the Accused Instrumentality provides numerous indoor gateway selections for use as a home gateway in a house and/or for use as an integrated access device ("IAD") in a building.[146] "The home gateway is generally installed in a house, and the IAD is installed in a building."[147] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities.

	See also discussion of Claim 1, *supra* page 1, *e.g.*, regarding the indoor gateway, *supra* page 13.
9. The internet network connecting and roaming system according to claim 1, wherein the indoor wireless connection module is a wireless LAN connection module.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the indoor wireless connection module is a wireless LAN connection module. For example, as described above with regard to claim 1, the Accused Instrumentality provides numerous indoor gateway selections comprising an indoor wireless connection module that is a wireless LAN connection module.[148] Indoor gateways listed above with regard to claim 1 comprise an indoor wireless connection module that is a wireless LAN (*i.e.*, Wi-Fi) connection module (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T-9 Mobile Hotspot).[149] Additionally, as described above with regard to claim 1, the Accused Instrumentality provides numerous data communication terminals comprising a wireless LAN connection module. Data communication terminals listed above with regard to claim 1 comprise an indoor wireless connection module that is a wireless LAN (*i.e.*, Wi-Fi) connection module (*e.g.*, Alcatel Go Flip 3; Joy Tab; Joy Tab Kids; Apple iPhone 12 Pro; iPhone 12; iPhone SE; iPhone 11; iPhone 11 Pro; iPhone 11 Pro Max; iPhone XR; iPad Air; iPad 8th gen; iPad Pro 11-inch 2nd gen; iPad Pro 12.9-inch 4th gen; iPad 7th gen; iPad Air 3rd gen; iPad mini; Motorola razr 5G; moto e; OnePlus 8T+ 5G; 8 5G; Samsung Galaxy S20 FE 5G; Note20 Ultra 5G; Z Fold2 5G; Note20 5G; A71 5G; A51 5G; S20 Ultra 5G; Z Flip 5G; A21; A11; A10e; S20 5G; S20+ 5G; Galaxy Tab S7 5G; Galaxy Tab S7+ 5G; Galaxy Tab A 8.4; and T-Mobile REVVL 5G; REVVL 4+; REVVL 4.).[150] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data connection terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data connection terminal, *supra* page 4, and indoor gateway, *supra* page 13.
10. The internet network connecting and roaming system according to claim 9, wherein the indoor gateway is an internet communication equipment connected with either a wired or wireless LAN.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 9, wherein the indoor gateway is an internet communication equipment connected with either a wired or wireless LAN. For example, as described above with regard to claim 1, the Accused Instrumentality provides numerous indoor gateways which are internet communication equipment connected with either wired or wireless LAN. Indoor gateways listed above with regard to claim 1 are internet communication equipment (*i.e.*, capable of supporting communication of data, voice, and the like at short range), and are connected with either a wired or wireless LAN (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T9 Mobile Hotspot).[151]

	It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 9, *supra* page 44; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the indoor gateway, *supra* page 13.
11. The internet network connecting and roaming system according to claim 1, wherein the indoor wireless connection module is a wireless packet communication connection module.	The Accused Instrumentalities provide an internet network connecting and roaming system according to claim 1, wherein the indoor wireless connection module is a wireless packet communication connection module. For example, as described above with regard to claim 1, the Accused Instrumentality provides numerous indoor gateways comprising a wireless packet communication connection module. Indoor gateways listed above with regard to claim 1 include modules for wireless packet communication connections such as wireless internet and/or wireless LAN (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T9 Mobile Hotspot).[152] Additionally, as described above with regard to claim 1, the Accused Instrumentality provides numerous data communication terminals comprising a wireless packet communication connection module. Data communication terminals listed above with regard to claim 1 include modules for wireless packet communication connections such as wireless mobile broadband and wireless LAN (*e.g.*, Alcatel Go Flip 3; Joy Tab; Joy Tab Kids; Apple iPhone 12 Pro; iPhone 12; iPhone SE; iPhone 11; iPhone 11 Pro; iPhone 11 Pro Max; iPhone XR; iPad Air; iPad 8th gen; iPad Pro 11-inch 2nd gen; iPad Pro 12.9-inch 4th gen; iPad 7th gen; iPad Air 3rd gen; iPad mini; Motorola razr 5G; moto e; OnePlus 8T+ 5G; 8 5G; Samsung Galaxy S20 FE 5G; Note20 Ultra 5G; Z Fold2 5G; Note20 5G; A71 5G; A51 5G; S20 Ultra 5G; Z Flip 5G; A21; A11; A10e; S20 5G; S20+ 5G; Galaxy Tab S7 5G; Galaxy Tab S7+ 5G; Galaxy Tab A 8.4; and T-Mobile REVVL 5G; REVVL 4+; REVVL 4.).[153] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data connection terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and indoor gateway, *supra* page 13.

12. An internet network connecting and roaming method for providing internet communication service to a data communication terminal of a user moving indoors or outdoors using an outdoor wireless internet network including an antenna, a router and a location register, and an indoor network including an indoor gateway connectable with an internet network, the method comprising:	Accused Instrumentalities provide an internet network connecting and roaming method. The preamble of this claim is not limiting, and the body of the claim defines the complete invention. However, should the preamble be construed to be limiting, KAIFI contends that Defendants' Accused Instrumentalities would satisfy the preamble because the Accused Instrumentalities provide an internet network connecting and roaming system providing internet communication service to a data communication terminal of a user moving indoors or outdoors, using an outdoor wireless internet network including an antenna, a router and a location register, and an indoor network including an indoor gateway connectable with an internet network, as described in more detail below with regard to the body of this claim. As a representative example of T-Mobile infringement, this chart maps the Accused Instrumentality for implementing T-Mobile Wi-Fi Calling system and service. T-Mobile's system enables "Wi-Fi Calling" which allows a user to make and receive calls and texts over a Wi-Fi connection.[154] **What is Wi-Fi calling?** − Wi-Fi Calling allows customers to make and receive calls and texts (SMS & MMS) over a Wi-Fi connection. Using Wi-Fi Calling is easy–customers won't even know they're making a Wi-Fi call. Simply connect to an available Wi-Fi network with a Wi-Fi calling-enabled smartphone and continue to make a call or send a text as you would over a cellular connection. No separate app or log-in or number is needed. T-Mobile's Wi-Fi Calling enables seamless switching or hand-off between its cellular (LTE) network and a Wi-Fi network.[155] **I know what Wi-Fi calling is. What's next-gen Wi-Fi calling?** − With next-gen Wi-Fi Calling, T-Mobile is pioneering a seamless handover between our LTE network and any available Wi-Fi connection so calls don't drop between the two. Next-gen Wi-Fi Calling also features HD Voice quality, when calling another HD Voice-capable user. This means our customers can now maintain crystal clear HD Voice calls, whether connected to T-Mobile LTE or Wi-Fi–all using their existing T-Mobile number.

Wi-Fi Calling enables Defendants' mobile and internet subscribers to "[e]xtend coverage in areas where no cellular network reaches."[156]

This a function of the LTE/EPC Network established by T-Mobile.[157]

> Think of this as a use case: you carry a device that can access, among other technologies, LTE and WiFi. You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi. The EPS network then includes features to maintain the sessions also during this handover between two quite different access technologies.

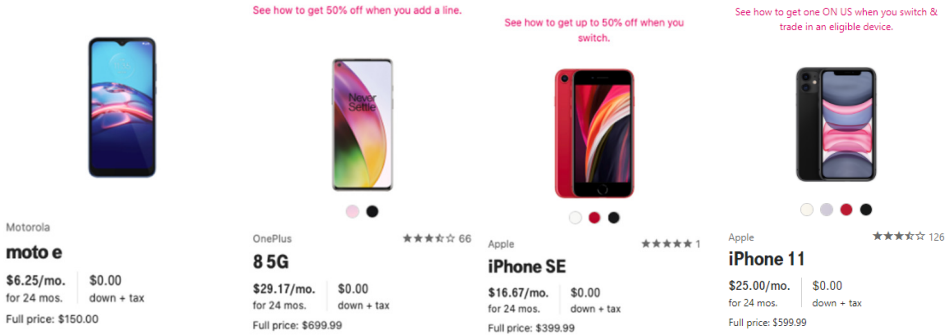
As another example, "You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi."[158]

> Think of this as a use case: you carry a device that can access, among other technologies, LTE and WiFi. You are connected to the LTE/EPC network and move indoors, into your house. There you have a fixed broadband connection connected to a WiFi-capable home router. Depending on preferences, the device may in this situation switch access from LTE to WiFi. The EPS network then includes features to maintain the sessions also during this handover between two quite different access technologies.[159]

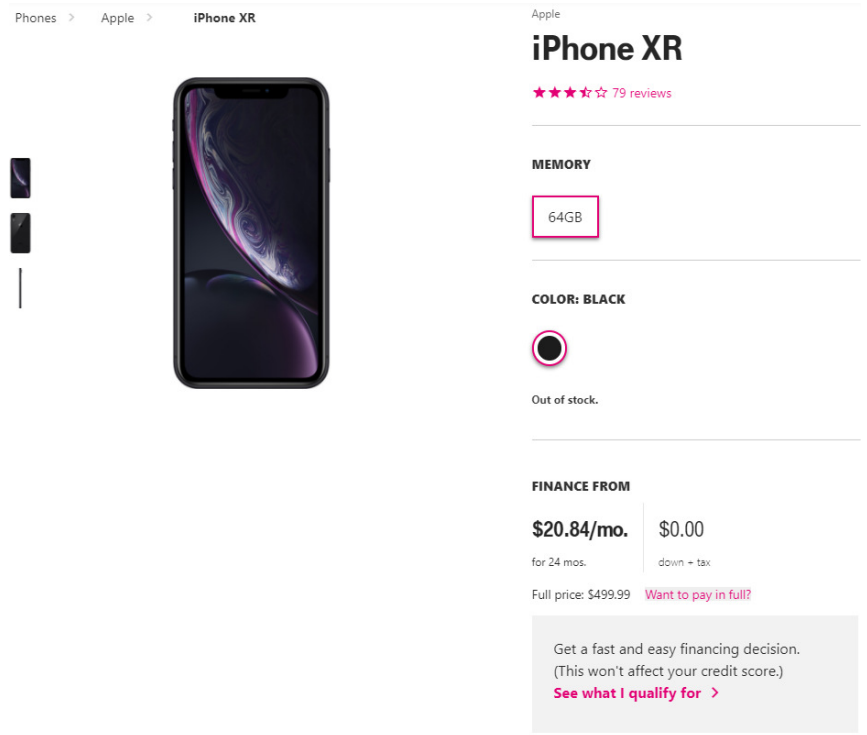
T-Mobile provides, directs, controls, and manages the foregoing instrumentalities.

> These T&Cs are an agreement between you an us, T-Mobile USA, Inc., and our controlled subsidiaries, assignees, and agents.
>
> Any equipment for which we provide Service or which we provide to you to be used with our Service, such as a phone, handset, tablet, SIM card, or accessory (collectively, a "Device");
>
> . . .
>
> Our wireless network is a shared resource, which we manage for the benefit of all of our customers. Your Data Plan is intended for Web browsing, messaging, and similar activities. Certain activities and uses of our Services and your Device are permitted and others are not. If you buy, lease, or finance a Device manufactured for use on our network, you agree, and we rely on your agreement, that you intend it to be activated on our Service and will not resell or modify the Device, or assist anyone doing so.
>
> Unless explicitly permitted by your Rate Plan or Data Plan, you are not permitted to use your

	Device or the Services in a way that we determine: • Compromises network security or capacity, degrades network performance, uses malicious software or "malware", hinders other customers' access to the network, or otherwise adversely impacts network service levels or legitimate data flows; • Uses applications which automatically consume unreasonable amounts of available network capacity; • Uses applications which are designed for unattended use, automatic data feeds, automated machine-to-machine connections, or applications that are used in a way that degrades network capacity or functionality; • Misuses the Service, including "spamming" or sending abusive, unsolicited, or other mass automated communications; • Accesses the accounts of others without authority; • Results in more than 50% of your voice and/or data usage being Off-Net (i.e., connected to another provider's network) for any 2 billing cycles within any 12-month period; • Results in unusually high usage (specifically, more 50GB (updated periodically) in a month) and the majority of your data usage being Smartphone Mobile HotSpot (tethering) usage for any 3 billing cycles within any 6-month period; • Resells the Service, either alone or as part of any other good or service;[160] Additionally and/or in the alternative, T-Mobile's system/service also includes configurations providing voice/data communications network connecting and roaming for streaming and browsing apps, including via T-Mobile and third-party apps. For example, T-Mobile also provides roaming of voice/data signals, such as media streaming through Binge On, which enables on demand streaming on T-Mobile Wireless, with "seamless" switching between networks.[161] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[162] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[163]

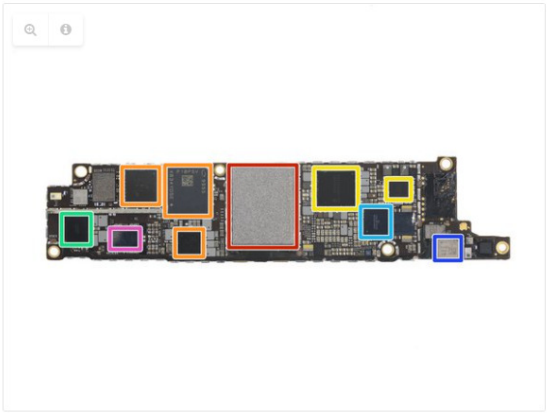
	It is anticipated that discovery will provide further details of the manner of infringement of the Accused Instrumentalities. Upon information and belief, as noted above with regard to Claim 1, KAIFI contends that these infringement contentions are equally applicable to all examples, aspects, applications, configurations, embodiments, and instances of T-Mobile's voice/data communications network connecting and roaming system and service, including but not limited to T-Mobile's Wi-Fi Calling and IP multimedia services. For example, these contentions are equally applicable to T-Mobile's Wi-Fi Calling as they are to T-Home Internet (including its LTE and 5G networks), T-Mobile Wi-Fi Services (including Wi-Fi hotspots), T-Vision, Binge On, Music Freedom, and any and all "over the top" media streaming services and IP Multimedia Subsystem services. It is anticipated that discovery will provide further details of the manner of infringement of the Accused Instrumentalities. *See also* discussion of Claim 1, *e.g.*, regarding the preamble, *supra* page 1, data communications terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21.
a first step of providing the user with a communication service by connecting with the outdoor wireless internet network when the user is located outdoors;	The Accused Instrumentalities provide a first step of providing the user with a communication service by connecting with the outdoor wireless internet network when the user is located outdoors. For example, the Accused Instrumentality provides users with communication service by connecting to the mobile LTE wireless network when outdoors. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[164] 

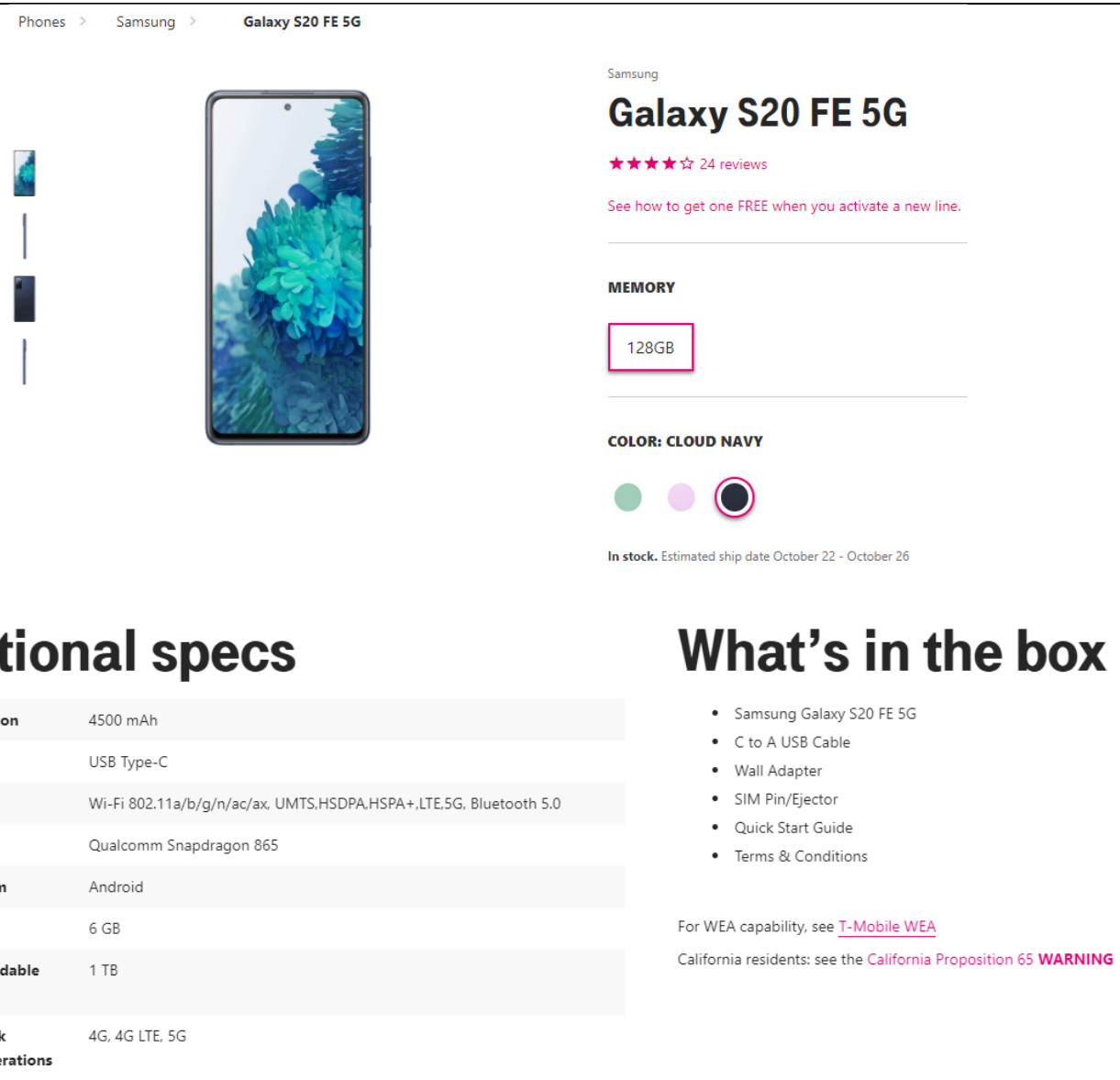
	An exemplary or representative example is the Apple iPhone, which is marketed by Defendants as being compatible with its 4G and 4G LTE networks.[165]



Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

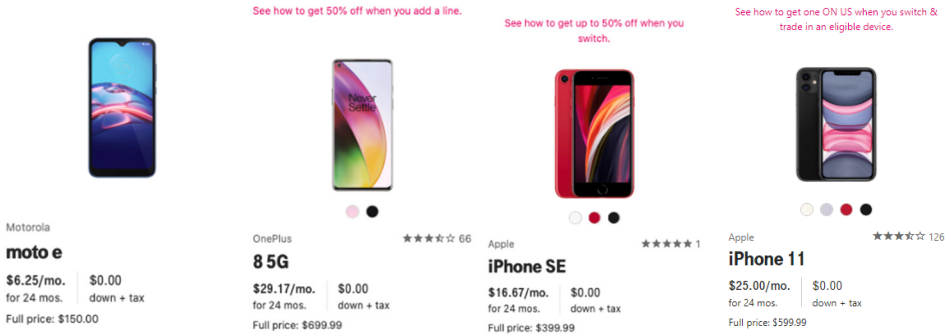
	Step 8  • More chips on the back side of the logic board. Show us your identification, please... • Toshiba TSB3243VC0428CHNA1 64 GB flash storage • Intel 9955 (likely the XMM7560 LTE Advanced Pro 4G LTE baseband processor), 5762 RF transceiver, and 5829 • Apple 338S00383-A0, 338S00375-A1 power management IC's (possibly from Dialog Systems) • Texas Instruments SN2600B1 battery charging IC • Apple 338S00248 audio codec (possibly from Cirrus Logic) • Skyworks 13768 front end module • Broadcom 59355A2IUB4G (likely a variation of the BCM59350 wireless power receiver chip) The Apple iPhone may be connected with the outdoor wireless internet network, e.g., T-Mobile's 4G or 4G LTE.[166] As another example, Defendants sell the Samsung Galaxy S20 FE 5G, which is marketed by Defendants as being "5G Capable" but also compatible with their 4G and 4G LTE networks as well.[167]



For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[168]

It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities.

To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "outdoor wireless internet network," Defendants' Accused Instrumentalities provide a substantial equivalent that

	differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a second step of determining whether when indoor system ID information is received by the data communication terminal and the received indoor system ID information is identical to indoor system ID information stored in the location register;	The Accused Instrumentalities provide a second step of determining whether when indoor system ID information is received by the data communication terminal and the received indoor system ID information is identical to indoor system ID information stored in the location register. For example, the Accused Instrumentality determines whether indoor system ID information (*e.g.*, Wi-Fi Network SSID), received by a mobile device data communication terminal, is identical to ID information stored in the location register. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[169]  An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[170]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

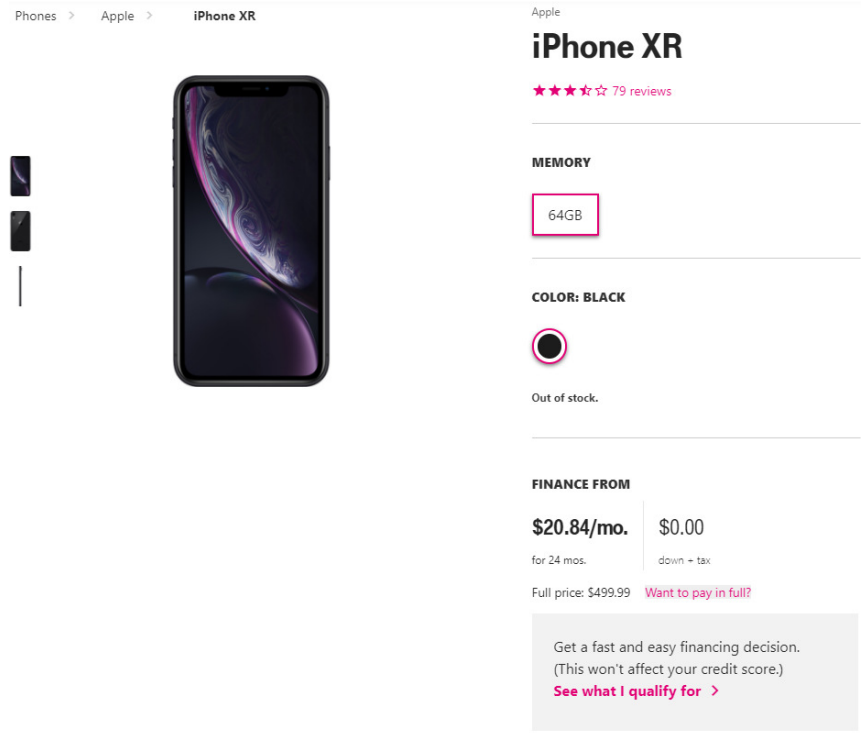
This device includes an indoor wireless connection module and receives indoor system ID information.[171]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

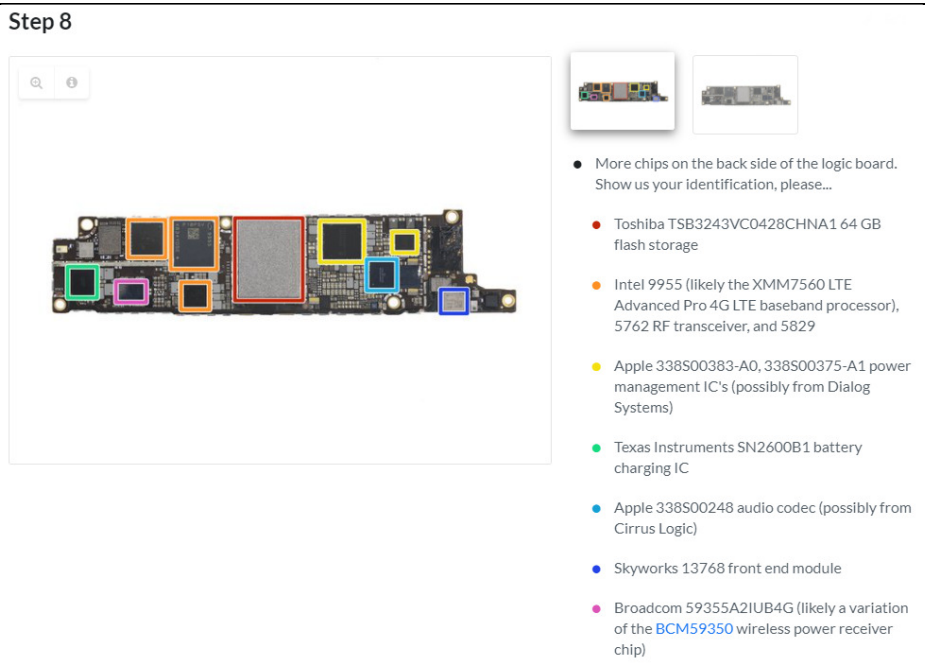
After you join the network, you'll see ✓ next to the network and in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

The Apple iPhone XR wireless data communication terminal includes Wi-Fi modem indoor wireless connection module.[172]

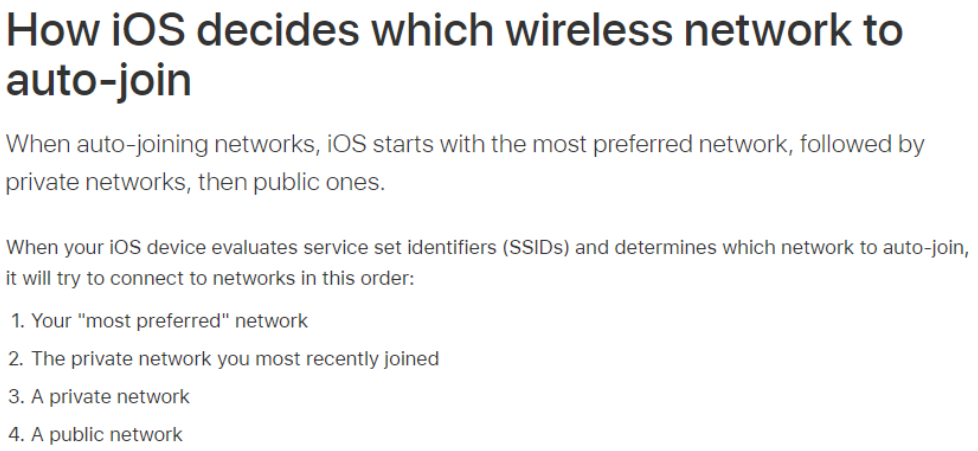

Phones
Apple
iPhone XR
Apple
iPhone XR
79 reviews
MEMORY
64GB
COLOR: BLACK
Out of stock.
FINANCE FROM
$20.84/mo.
for 24 mos.
$0.00
down + tax
Full price: $499.99
Want to pay in full?
Get a fast and easy financing decision.
(This won't affect your credit score.)
See what I qualify for

Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71



For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[173]



The device receives this information so that it may be connected with the indoor network if the indoor system ID information matches stored indoor system ID information.[174]

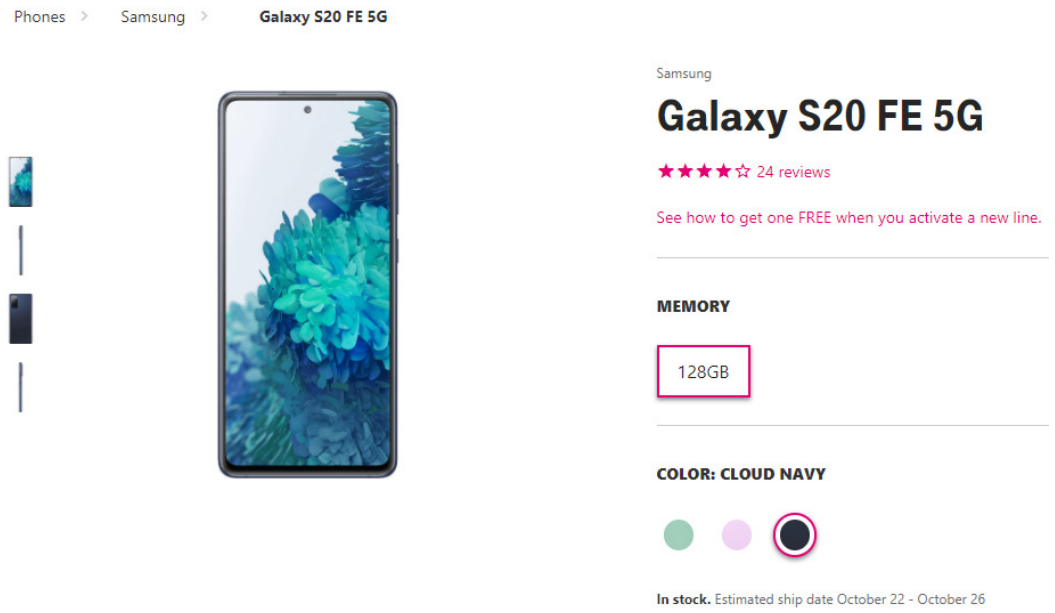
Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device?

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[175]



Additional specs

Battery Description	4500 mAh
Ports	USB Type-C
Connectivity	Wi-Fi 802.11a/b/g/n/ac/ax, UMTS,HSDPA,HSPA+,LTE,5G, Bluetooth 5.0
Processor	Qualcomm Snapdragon 865
Operating System	Android
Ram	6 GB
Maximum Expandable Memory	1 TB
Wireless Network Technology Generations	4G, 4G LTE, 5G

What's in the box

- Samsung Galaxy S20 FE 5G
- C to A USB Cable
- Wall Adapter
- SIM Pin/Ejector
- Quick Start Guide
- Terms & Conditions

For WEA capability, see T-Mobile WEA

California residents: see the California Proposition 65 **WARNING**

The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[176]

	Qualcomm® FastConnect™ Subsystem **Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Cellular Modem** **Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system **Cellular Technology** **Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support **Wi-Fi** **Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency The data communication terminals receive indoor system ID information, such as a Wi-Fi network SSID.[177] The terminals connect with an indoor network, such as a home or office Wireless LAN or Wi-Fi network, if the indoor system ID information matches stored indoor system ID information.[178] For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[179] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities.

	Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise "indoor system ID information," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a third step of going through authentication of an indoor location of the data communication terminal by the location register and storing the indoor location into the location register if it is determined in the second step that the two of ID information are equal to each other;	The Accused Instrumentalities provide a third step of going through authentication of an indoor location of the data communication terminal by the location register and storing the indoor location into the location register if it is determined in the second step that the two of ID information are equal to each other. For example, the Accused Instrumentality authenticates an indoor location of the mobile device data communication terminal by the location register, and stores the indoor location into the location register if it is determined that the received indoor system ID information is equal to indoor system ID information stored in the location register. Additionally and/or in the alternative, the location register in the Accused Instrumentality authenticates a data communication terminal's indoor location and stores the indoor location if the received indoor system ID information matches the stored indoor system ID information. For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[180]

5G

- Frequencies that can provide 5G:
  - **Band n71** (600 MHz)
  - **Band n41** (2.5 GHz)
  - **Band n260** (39 GHz)
  - **Band n261** (28 GHz)
- With 5G, high amounts of data can be transmitted more efficiently than 4G LTE.
- One of the ways T-Mobile is rapidly deploying 5G is integrating mid-band 2.5 GHz spectrum from Sprint.
- Check out **What is 5G?** to learn how it works!

Extended Range 4G LTE

- Frequencies that can provide Extended Range LTE
  - **Band 12** (700 MHz)
  - **Band 71** (600 MHz)
- Our Extended Range LTE signal reaches 2X as far and penetrates walls for 4X better coverage in-buildings than ever before.

4G LTE

- Frequencies that can provide LTE:
  - **Band 2** (1900 MHz)
  - **Band 5** (850 MHz)
  - **Band 4** (1700/2100 MHz)
  - **Band 66** (Extension of band 4 on 1700/2100 MHz).
- 4G LTE offers fast download speeds, up to 50% faster speeds than 3G. See **Data speeds**.
- Voice and data services only work at the same time when on you have VoLTE enabled on your device. Otherwise, LTE only provides data.

- VoLTE ("Voice over LTE") ⊕

The 4G LTE Network uses the 3GPP EPC (Evolved Packet Core) and E-UTRAN (Evolved UMTS Terrestrial Radio Access Network). The EPC/E-UTRAN architecture is designed to allow interworking between different access technologies and, in particular LTE and Wi-Fi. In this network architecture, the HSS (Home Subscriber Server) acts as a common database for all subscriber data.[181]

The HSS "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[182]

Within the EPC, the HSS connects via SWx interface to the 3GPP AAA (Authentication, Authorization, and Accounting) Server, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[183]

As one example, EAP (Extensible Authentication Protocol) is used by a 3GPP AAA server as provided by the Accused Instrumentalities such that a data communication terminal is registered and authenticated by the

location register.[184] As another example, encrypted tunnels are established between a data communication terminal and the EPC using IPsec, which creates a logical association between each terminal and the network, whereby the terminal is registered and authenticated by the location register.[185]

The 3GPP standard illustrates this.[186]

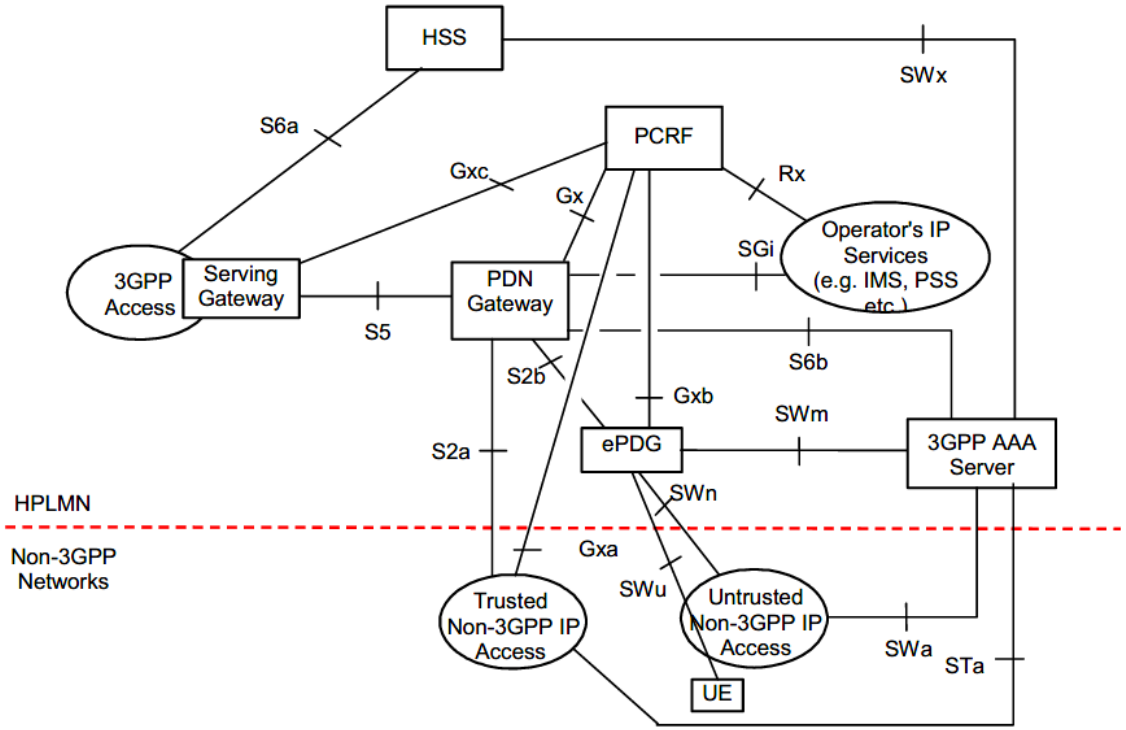


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

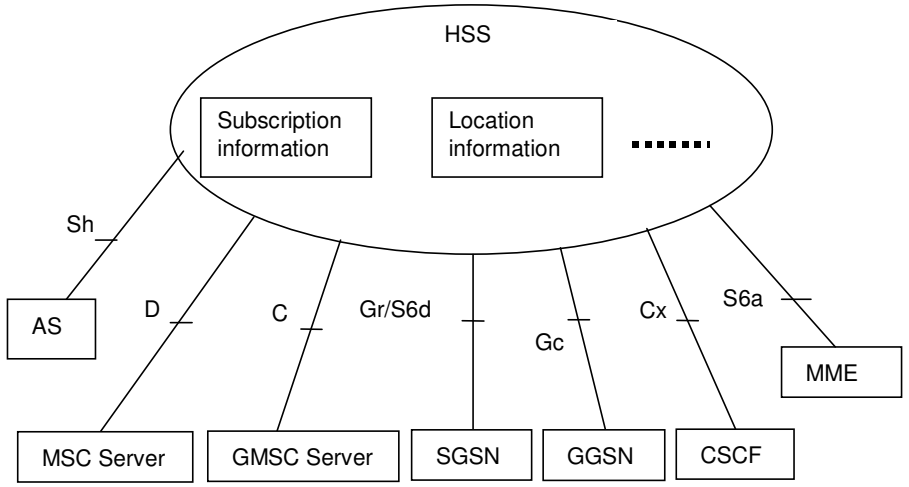
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[187]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN GW (Packet Data Network Gateway), the ePDG (Evolved Packet Data Gateway), Trusted Non-3GPP IP Access Networks, and Untrusted Non-3GPP IP Access Networks. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor).[188]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[189] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[190]



The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for Evolved Packet System (EPS) 3GPP access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[191]

As another example, the HSS stores the "subscribed QoS profile."[192]

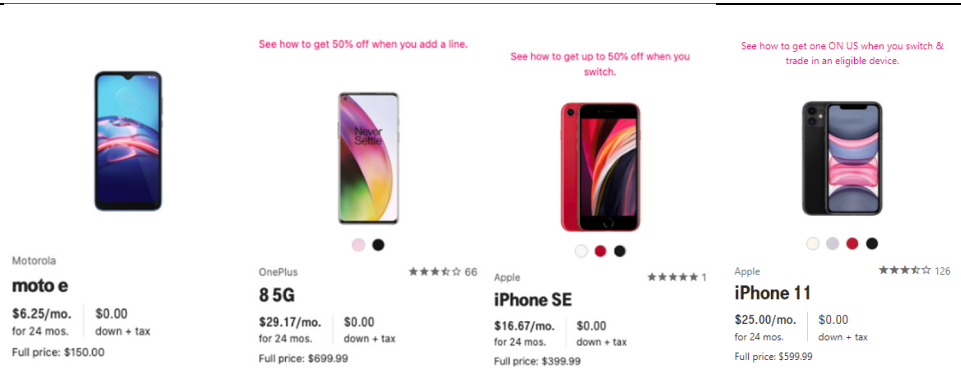
In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[193]

A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[194]

An APN is the label for the Wi-Fi access point.[195]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[196] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[197]

	Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[198] Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[199] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[200] Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor location," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a fourth step of connecting with the internet network by switching connection of the data communication terminal from the outdoor wireless internet network to the indoor gateway and making wireless communications through the indoor gateway and an indoor wireless connection module;	The Accused Instrumentalities provide a fourth step of connecting with the internet network by switching connection of the data communication terminal from the outdoor wireless internet network to the indoor gateway and making wireless communications through the indoor gateway and an indoor wireless connection module. For example, the Accused Instrumentality connects with the internet network by switching connection of the mobile device from the outdoor wireless network to the indoor gateway. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[201]



An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[202]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

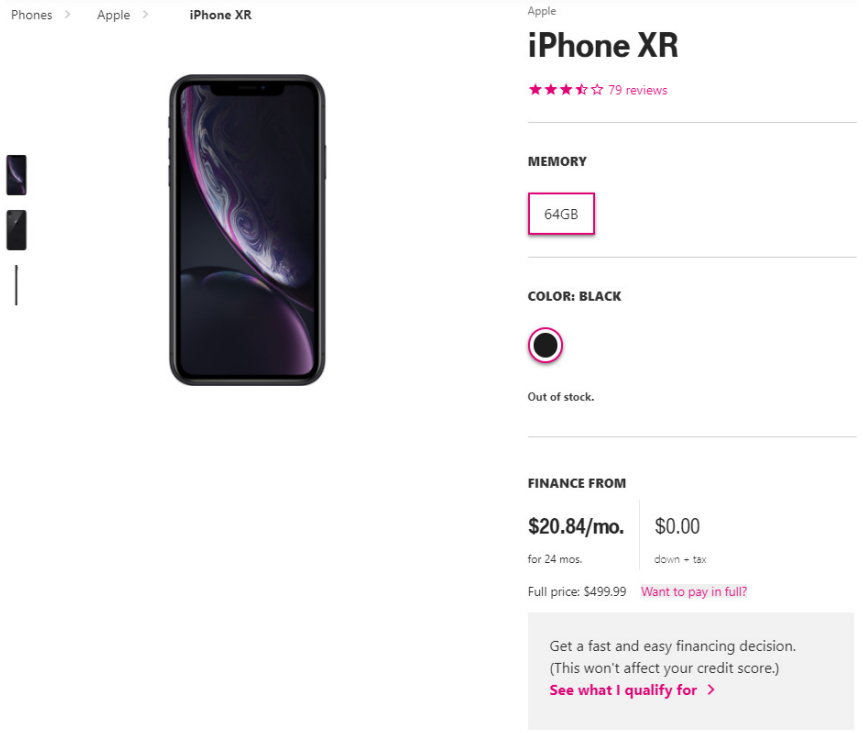
This device includes an indoor wireless connection module and stores registered indoor system ID information.[203]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

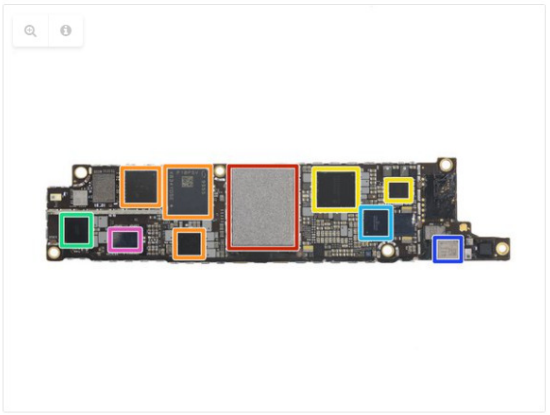
The Apple iPhone XR wireless data communication terminal includes Wi-Fi modem indoor wireless connection module.[204]

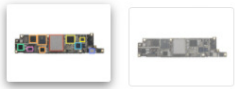


Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

Step 8





- More chips on the back side of the logic board. Show us your identification, please...
  - Toshiba TSB3243VC0428CHNA1 64 GB flash storage
  - Intel 9955 (likely the XMM7560 LTE Advanced Pro 4G LTE baseband processor), 5762 RF transceiver, and 5829
  - Apple 338S00383-A0, 338S00375-A1 power management IC's (possibly from Dialog Systems)
  - Texas Instruments SN2600B1 battery charging IC
  - Apple 338S00248 audio codec (possibly from Cirrus Logic)
  - Skyworks 13768 front end module
  - Broadcom 59355A2IUB4G (likely a variation of the BCM59350 wireless power receiver chip)

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[205]

How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The Apple iPhone may be connected with the indoor network.[206]

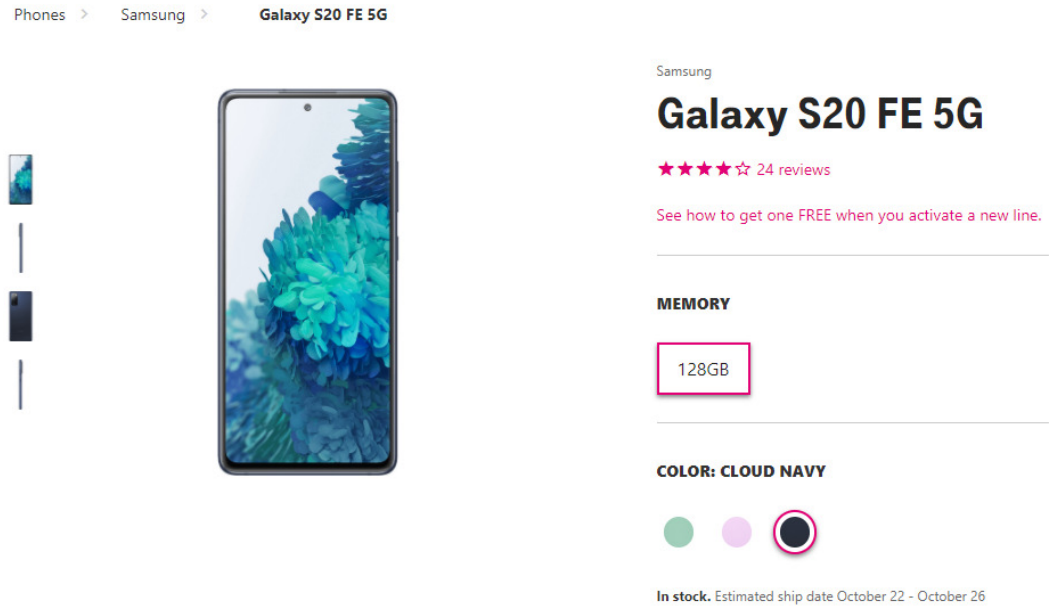
Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device?

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[207]



Additional specs

Battery Description	4500 mAh
Ports	USB Type-C
Connectivity	Wi-Fi 802.11a/b/g/n/ac/ax, UMTS,HSDPA,HSPA+,LTE,5G, Bluetooth 5.0
Processor	Qualcomm Snapdragon 865
Operating System	Android
Ram	6 GB
Maximum Expandable Memory	1 TB
Wireless Network Technology Generations	4G, 4G LTE, 5G

What's in the box

- Samsung Galaxy S20 FE 5G
- C to A USB Cable
- Wall Adapter
- SIM Pin/Ejector
- Quick Start Guide
- Terms & Conditions

For WEA capability, see T-Mobile WEA

California residents: see the California Proposition 65 **WARNING**

The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[208]

	Qualcomm® FastConnect™ Subsystem **Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Cellular Modem** **Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system **Cellular Technology** **Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support **Wi-Fi** **Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency The data communication terminals store registered indoor system ID information, such as a Wi-Fi network SSID.[209] The terminals connect with an indoor network, such as a home or office Wireless LAN or Wi-Fi network, if the registered indoor system ID information is received.[210] For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[211] Additionally and/or in the alternative, the Accused Instrumentality "seamlessly" transitions the voice or data signal from the outdoor 4G LTE cellular network to the Wi-Fi network to "[e]xtend[] coverage in areas where

no cellular network reaches."[212] And "when the device is in range of a reliable Wi-Fi network, Wi-Fi calls and cellular calls are similar in quality. In fact, T-Mobile is the only major national carrier to offer HD Voice on Wi-Fi, and VoLTE for crystal clear HD Voice quality."[213] Furthermore, "T-Mobile is pioneering a seamless handover between our LTE network and any available Wi-Fi connection so calls don't drop between the two."[214]

For example, Defendants' 4G LTE Network includes a PDN GW (Packet Data Network Gateway).[215]

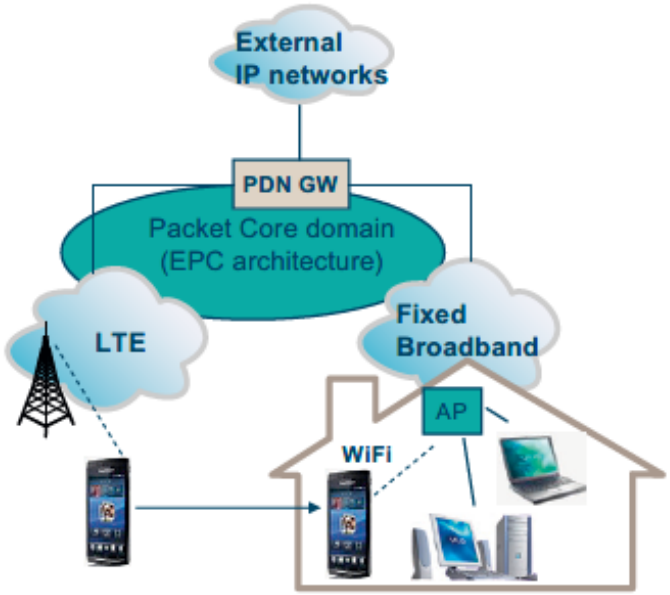


Figure 2.16: Interworking Between 3GPP Access and Non-3GPP Access Technologies.

This is further illustrated by the 3GPP standards.[216]

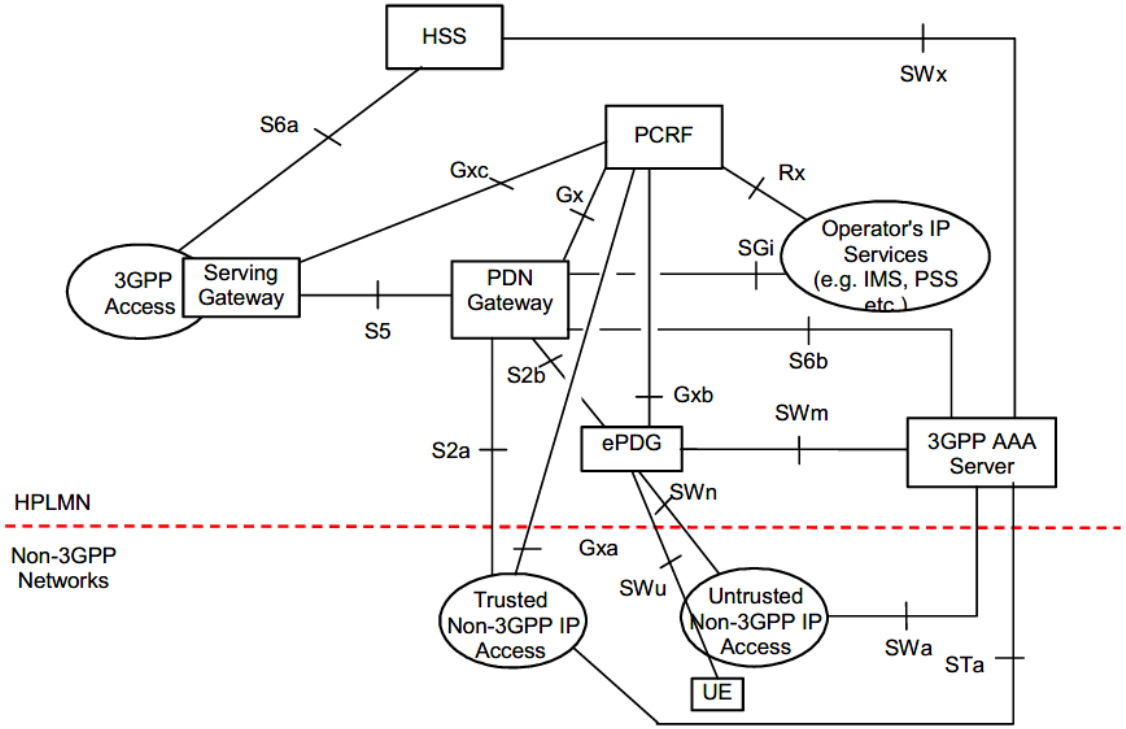


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

The PDN GW is the point of interconnect between the EPC and external IP networks. IP traffic runs through the PDN GW. The PDN GW interfaces the 3GPP AAA Server to retrieve subscriber data stored in the HSS, including location information stored in the location register.[217]

The PDN GW routes packets to and from the various packet data networks.[218]

The PDN GW provides roaming for voice and data signals to the user by selecting the LTE (outdoor) network or Wi-Fi (indoor) network in accordance with the location of the data communication terminal.[219]

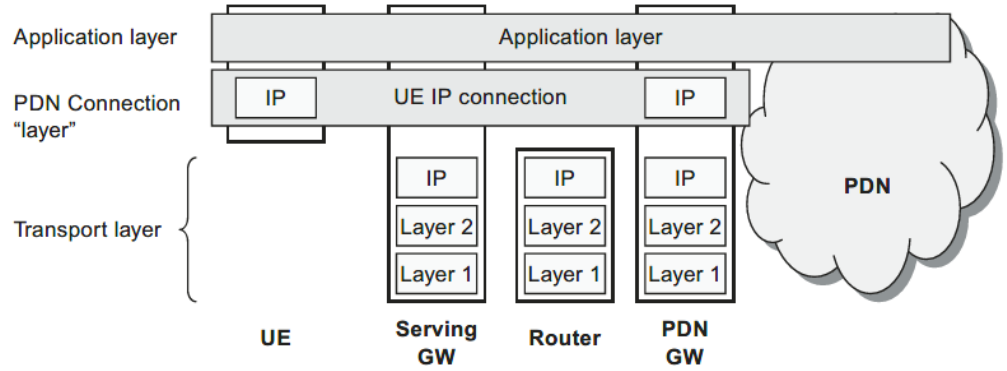


Figure 6.3: Schematic View of Application, PDN Connection, and Transport Layers for 3GPP Family of Accesses.

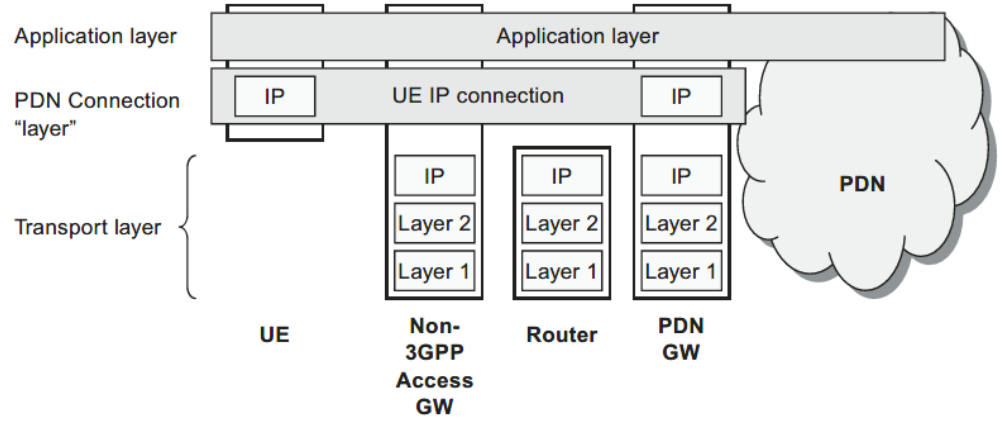


Figure 6.4: Schematic View of Application, PDN Connection, and Transport Layers for Trusted Non-3GPP Accesses When PMIP or GTP Is Used on S2a.

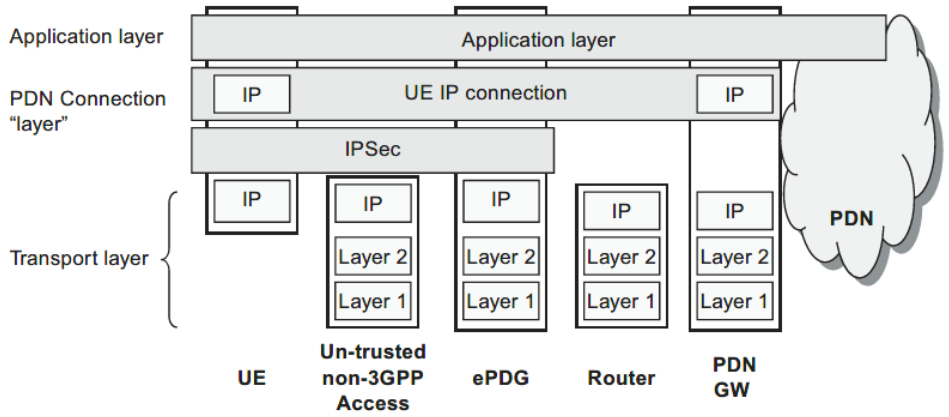


Figure 6.5: Schematic View of Application, PDN Connection, and Transport Layers for Untrusted Non-3GPP Accesses When PMIP or GTP Is Used on S2b.

Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[220]

The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[221]

It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities.

Each data communication terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "outdoor wireless internet network," "indoor gateway," or "indoor wireless connection module," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents.

	See also discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a fifth step of, when the data provided from the internet network in accordance with location information stored in the location register are transferred to the indoor gateway, supplying the data communication terminal with the data through the indoor gateway and the indoor wireless connection module;	The Accused Instrumentalities provide a fifth step of, when the data provided from the internet network in accordance with location information stored in the location register are transferred to the indoor gateway, supplying the data communication terminal with the data through the indoor gateway and the indoor wireless connection module. For example, the Accused Instrumentality supplies the mobile device, through the indoor gateway and through the indoor wireless connection module, with the data provided from the internet network in accordance with location information stored in the location register. An indoor gateway wireless access point or node for connecting to a LAN and the internet with a wire, such as a home or business gateway, router, "hotspot," mesh-network node, or ad hoc network node. A Wi-Fi access point broadcasts indoor system ID information (*e.g.*, network SSID), and makes wireless communications with the data communication terminal through the indoor wireless connection module.[222] **What is an Access Point?** An access point is a device that creates a wireless local area network, or WLAN, usually in an office or large building. An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area. For example, if you want to enable Wi-Fi access in your company's reception area but don't have a router within range, you can install an access point near the front desk and run an Ethernet cable through the ceiling back to the server room. The Wi-Fi Calling system and service can be used with "any available Wi-Fi connection."[223] For example, Defendants provide a Wi-Fi Gateway and access to a network of nationwide Wi-Fi hotspots.[224] **What is T-Mobile Home Internet?** T-Mobile Home Internet is a new offering from T-Mobile, available at certain addresses in limited areas. It's fast, affordable home internet service that lets you do it all for just $50 a month with AutoPay. T-Mobile Home Internet service connects to the same great LTE network T-Mobile smartphones run on. You receive service through an LTE Wi-Fi Gateway device (which combines the capabilities of a router and a modem), converts the LTE signal to Wi-Fi, and provides a Wi-Fi signal accessible by all the devices in your home. You'll also get T-Mobile's amazing customer support to answer all your questions! T-Mobile provides an indoor gateway, e.g., LTE Wi-Fi Gateway (TM-RTL0102), and Wi-Fi CellSpot Router (T-Mobile AC-1900), to its customers.[225] Furthermore, T-Mobile's indoor gateways may be connected to the internet via a wire, *see, e.g.,* T-Mobile's CellSpot "[r]equires a wired high-speed internet connection" and "[o]n the back the CellSpot has … one Gigabit WAN port (to connect to an Internet source, such as a broadband modem)"[226]

How do I set up T-Mobile Home Internet?

Simply power up your LTE Wi-Fi Gateway, download the T-Mobile Home Internet app (Android or iOS), and follow a few instructions. And if you have any trouble, you can contact our T-Mobile Home Internet support team through the app or at 1-844-275-9310 for 24x7 assistance.

T-Mobile provides Wi-Fi hotspots (for internet).[227]

T-Mobile provides Wi-Fi hotspots through Boingo Wireless ("Boingo"), "the Wi-Fi industry's leading nationwide provider of software and services."

> With the new agreement, T-Mobile Hotspot and postpaid mobile broadband subscribers will now have Wi-Fi access at no additional charge at 53 Boingo airport locations in the United States and Canada, including major airports in the New York and Chicago metropolitan areas. The expanded agreement also includes the Washington State Ferries in the Seattle area.
>
> Similarly, Boingo subscribers will have continued Wi-Fi access at T-Mobile Hotspot airport locations and expanded access at T-Mobile HotSpot airline club and hotel locations, including the airline clubs of American Airlines, United Airlines, US Airways and Delta Airlines and Hyatt hotels.
>
> "Expanding our agreement with T-Mobile USA reinforces our commitment to delivering customers seamless Wi-Fi access to a larger, collective footprint," said Colby Goff, senior vice president of strategy for Boingo Wireless. "We pride ourselves in listening to our customers and giving them access to Wi-Fi when and where they need it. Boingo users can now enjoy connectivity at airport lounges – a top request – and we welcome T-Mobile subscribers to our airport and ferry networks."[228]

T-Mobile also provides Wi-Fi hotspot devices, including but not limited to: T9 Mobile Hotspot and Linkzone 2.[229]

T-Mobile provides Home Internet and Wi-Fi Services:[230]

Are there ways I can't use Home Internet?

You can use your Home Internet for all the homework, streaming, and video conferencing you need! But to ensure that our network is available for all customers, there are some restrictions on activities that can damage or disproportionately congest the network. For example, Home Internet is not intended for unattended use, automatic data feeds, automated machine-to-machine connections, or uses that automatically consume unreasonable amounts of available network capacity. Please see T-Mobile's Terms and Conditions for prohibited uses.

> T-Mobile and Sprint are now part of the same family. While T-Mobile is working to build a combined network, the Sprint network continues to operate. Sprint customers' traffic may be carried in some areas by the T-Mobile network (e.g. where T-Mobile's network is available and

Sprint's is not). These Sprint customers will continue to experience the network management practices disclosed on Sprint's Open Internet page, but while on the T-Mobile network can expect to experience the speeds and data prioritization disclosed on this page.

...

Broadband Internet Access Services are subject to the T-Mobile Terms and Conditions at https://www.t-mobile.com/responsibility/legal/terms-and-conditions. Specific information about our Broadband Internet Access Services can be found under the heading "Using Our Network" Certain uses of our network are also prohibited as described in our Terms and Conditions under the heading "Examples of Permitted and Prohibited Uses of the Services and Your Device." E-Rate and other government or enterprise customers' use of T-Mobile's Broadband Internet Access Services may also be governed by an applicable government contract or Major Account Agreement.[231]

Our wireless network is a shared resource, which we manage for the benefit of all of our customers. Your Data Plan is intended for Web browsing, messaging, and similar activities. Certain activities and uses of our Services and your Device are permitted and others are not. If you buy, lease, or finance a Device manufactured for use on our network, you agree, and we rely on your agreement, that you intend it to be activated on our Service and will not resell or modify the Device, or assist anyone doing so. Here are examples of permitted and prohibited uses.

Permitted uses include:

- Voice calls;
- Web browsing;
- Messaging;
- Email;
- Streaming music;
- Uploading and downloading applications and content to and from the Internet or third party stores;
- Using applications and content without excessively contributing to network congestion;

	and • Tethering your Device to other non-harmful devices pursuant to the terms and conditions and allotments of your Data Plan.[232] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. Each data communication terminal, indoor gateway, and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor gateway" or "indoor wireless connection module," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a sixth step of going through authentication of an outdoor location of the data communication terminal by the location register and storing the outdoor location into the location register when the indoor system ID information is not received; and	The Accused Instrumentalities provide a sixth step of going through authentication of an outdoor location of the data communication terminal by the location register and storing the outdoor location into the location register when the indoor system ID information is not received. For example, the Accused Instrumentality authenticates an outdoor location of the mobile device by the location register, and stores the outdoor location into the location register when the indoor system ID information is not received. Additionally and/or in the alternative, the location register in the Accused Instrumentality authenticates a data communication terminal's outdoor location and stores the outdoor location if the received indoor system ID information is not received.

The HSS (Home Subscriber Server) "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[233]

Within the EPC, the HSS connects via SWx interface to the 3GPP AAA (Authentication, Authorization, and Accounting) Server, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[234]

As one example, EAP (Extensible Authentication Protocol) is used by a 3GPP AAA server as provided by the Accused Instrumentalities such that a data communication terminal is registered and authenticated by the location register.[235] As another example, encrypted tunnels are established between a data communication terminal and the EPC using IPsec, which creates a logical association between each terminal and the network, whereby the terminal is registered and authenticated by the location register.[236]

The 3GPP standard illustrates this.[237]

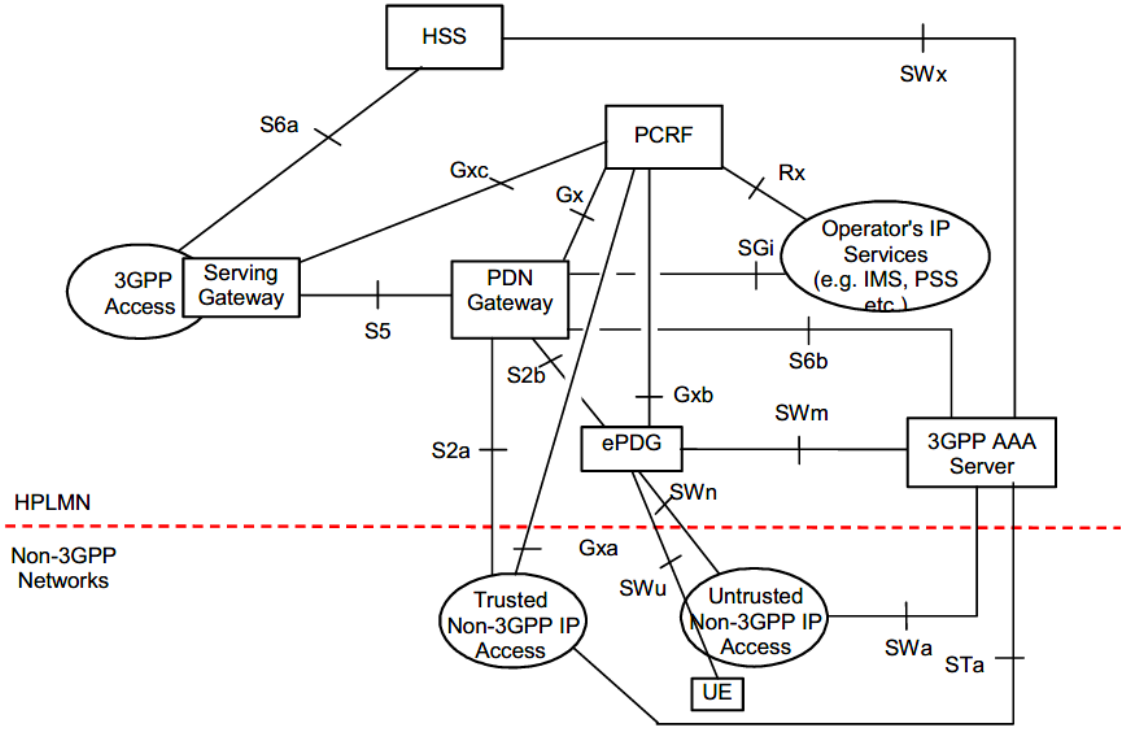


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

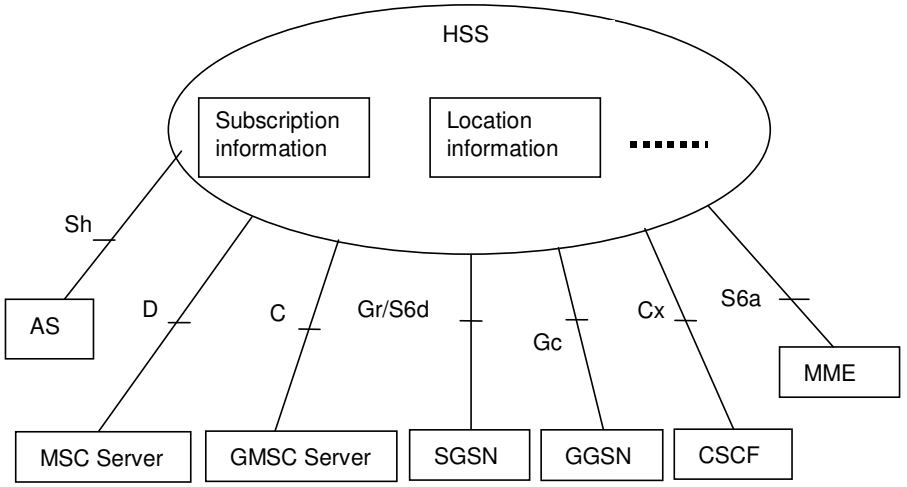
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[238]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN GW (Packet Data Network Gateway) over the S6b interface; the ePDG (Evolved Packet Data Gateway) over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor).[239]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[240] There may be more than one GMLC.

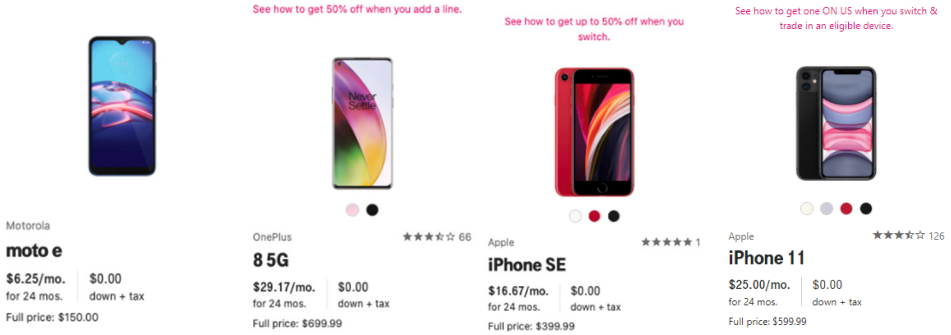
The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[241]

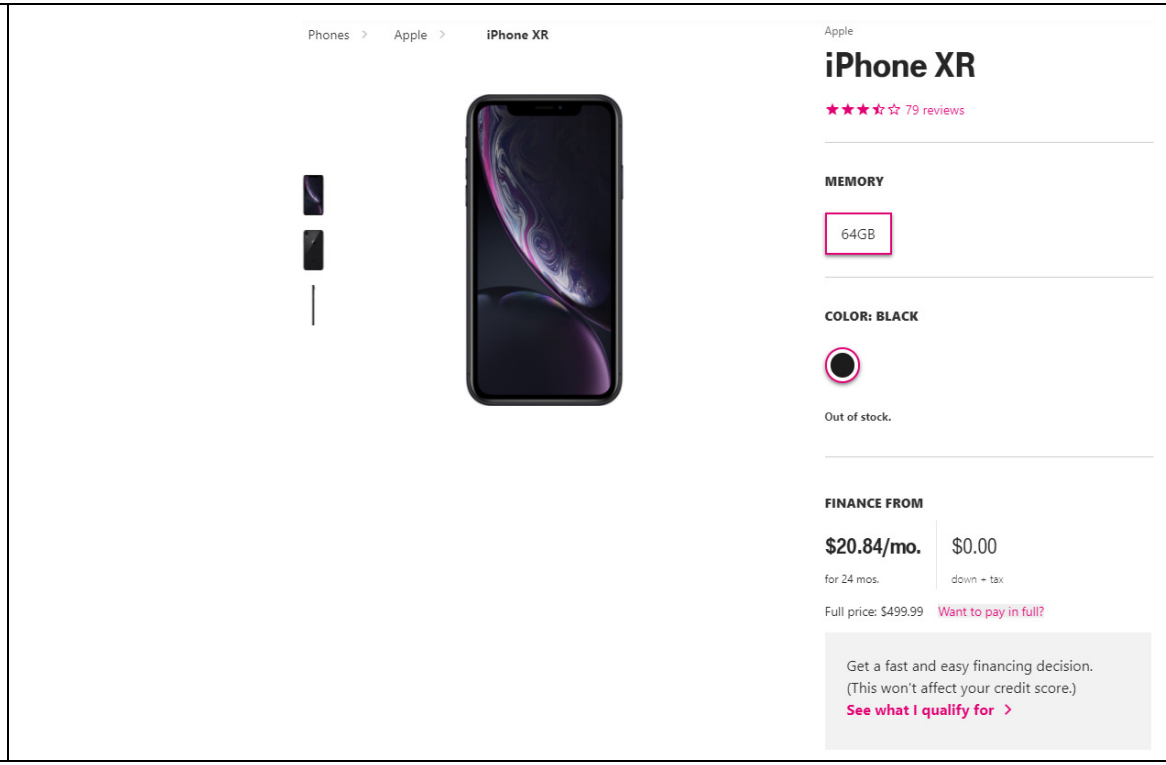


The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for 3GPP EPS (Evolved Packet System) access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[242]

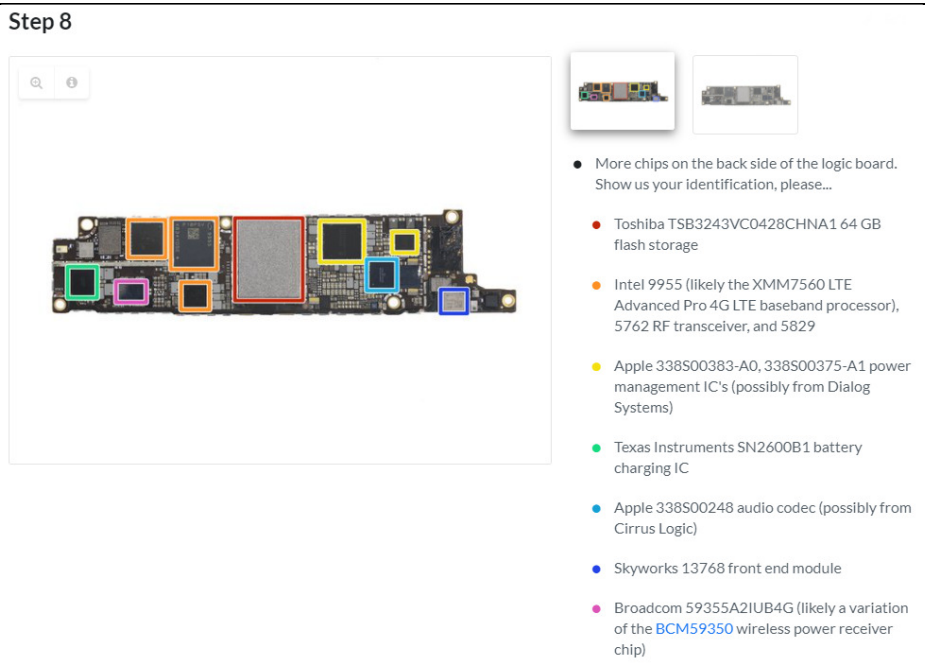
	As another example, the HSS stores the "subscribed QoS profile."[243] In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[244] A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[245] An APN is the label for the Wi-Fi access point.[246] Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[247] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[248] Additionally and/or in the alternative, various forms of location information are provided by the Accused Instrumentalities, including but not limited to CID (Cell Identification) and TDOA (Time Difference of Arrival). Such location information is utilized in relation with various aspects of the Accused Instrumentalities, including but not limited to an E-SMLC (Enhanced Serving Mobile Location Center), MME (Mobility Management Entity), and GMLC (Gateway Mobile Location Center).[249] Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[250] Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[251] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[252] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[253] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "outdoor location" or "indoor system ID information," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if

	Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
a seventh step of switching the connection of the data communication terminal from the indoor gateway to the outdoor wireless internet network and performing the first step again.	The Accused Instrumentalities provide a seventh step of switching the connection of the data communication terminal from the indoor gateway to the outdoor wireless internet network and performing the first step again. For example, the Accused Instrumentality switches the connection of the mobile device from the indoor gateway to the outdoor wireless internet network. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[254]  An exemplary or representative example is the Apple iPhone XR, which is marketed by Defendants as being compatible with its 4G and 4G LTE networks.[255]


Phones
Apple
iPhone XR
Apple
iPhone XR
79 reviews
MEMORY
64GB
COLOR: BLACK
Out of stock.
FINANCE FROM
$20.84/mo.
for 24 mos.
$0.00
down + tax
Full price: $499.99
Want to pay in full?
Get a fast and easy financing decision.
(This won't affect your credit score.)
See what I qualify for

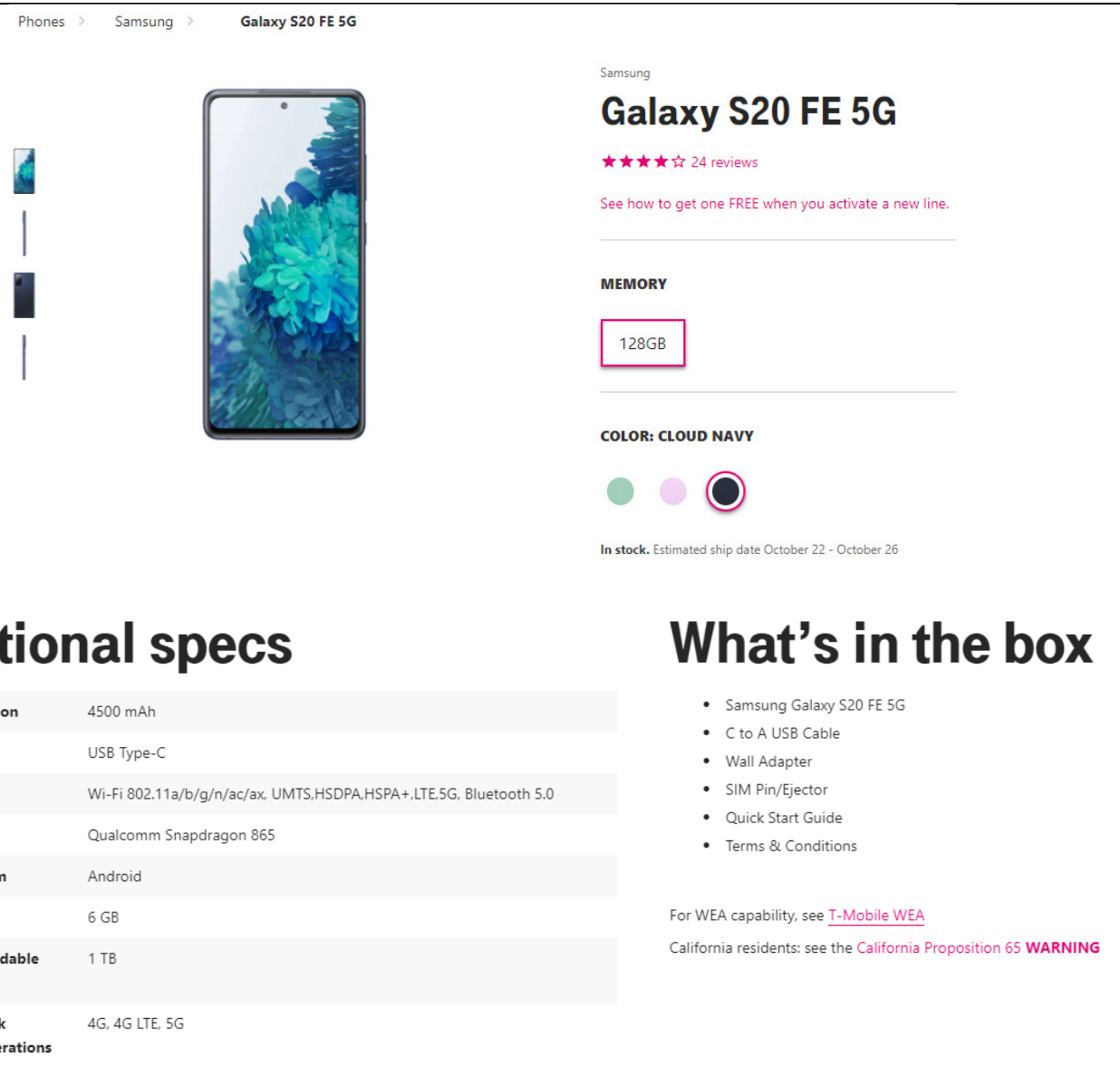
Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71



The Apple iPhone may be connected with the outdoor wireless internet network, e.g., T-Mobile's 4G or 4G LTE.[256]

As another example, Defendants sell the Samsung Galaxy S20 FE 5G, which is also marketed by Defendants as being 5G capable but also compatible with their 4G and 4G LTE networks as well.[257]



For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[258]

5G

- Frequencies that can provide 5G:
  - **Band n71** (600 MHz)
  - **Band n41** (2.5 GHz)
  - **Band n260** (39 GHz)
  - **Band n261** (28 GHz)
- With 5G, high amounts of data can be transmitted more efficiently than 4G LTE.
- One of the ways T-Mobile is rapidly deploying 5G is integrating mid-band 2.5 GHz spectrum from Sprint.
- Check out **What is 5G?** to learn how it works!

Extended Range 4G LTE

- Frequencies that can provide Extended Range LTE
  - **Band 12** (700 MHz)
  - **Band 71** (600 MHz)
- Our Extended Range LTE signal reaches 2X as far and penetrates walls for 4X better coverage in-buildings than ever before.

4G LTE

- Frequencies that can provide LTE:
  - **Band 2** (1900 MHz)
  - **Band 5** (850 MHz)
  - **Band 4** (1700/2100 MHz)
  - **Band 66** (Extension of band 4 on 1700/2100 MHz).
- 4G LTE offers fast download speeds, up to 50% faster speeds than 3G. See **Data speeds**.
- Voice and data services only work at the same time when on you have VoLTE enabled on your device. Otherwise, LTE only provides data.

- VoLTE ("Voice over LTE") ⊕

The 4G LTE Network uses the 3GPP EPC (Evolved Packet Core) and Evolved UMTS Terrestrial Radio Access Network (E-UTRAN). The EPC/E-UTRAN architecture is designed to allow interworking between different access technologies and, in particular LTE and Wi-Fi. In this network architecture, the HSS (Home Subscriber Server) acts as a common database for all subscriber data.[259]

If the registered indoor system ID information is not received, the terminal connects with the outdoor wireless internet network, such as T-Mobile's cellular telephony system and service. For example, "[t]he primary responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[260] "The platform will ultimately decide on which network the device connects to."[261]

For example, Defendants' 4G LTE Network includes a PDN GW (Packet Data Network Gateway).[262]

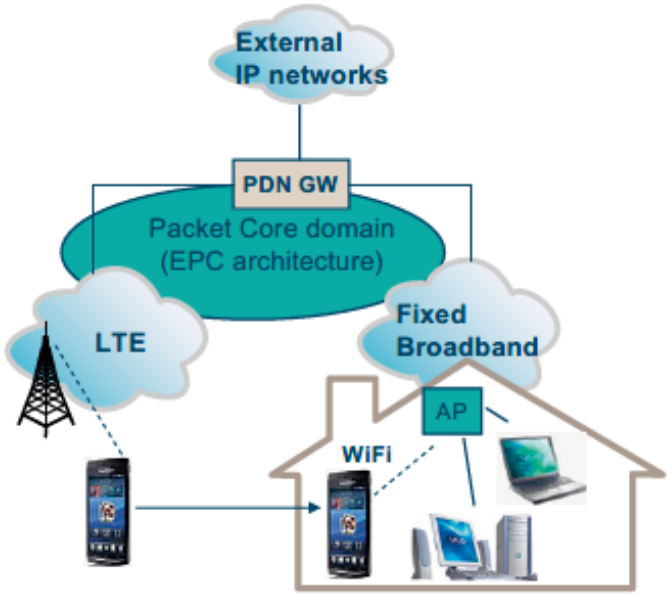


Figure 2.16: Interworking Between 3GPP Access and Non-3GPP Access Technologies.

This is further illustrated by the 3GPP standards.[263]

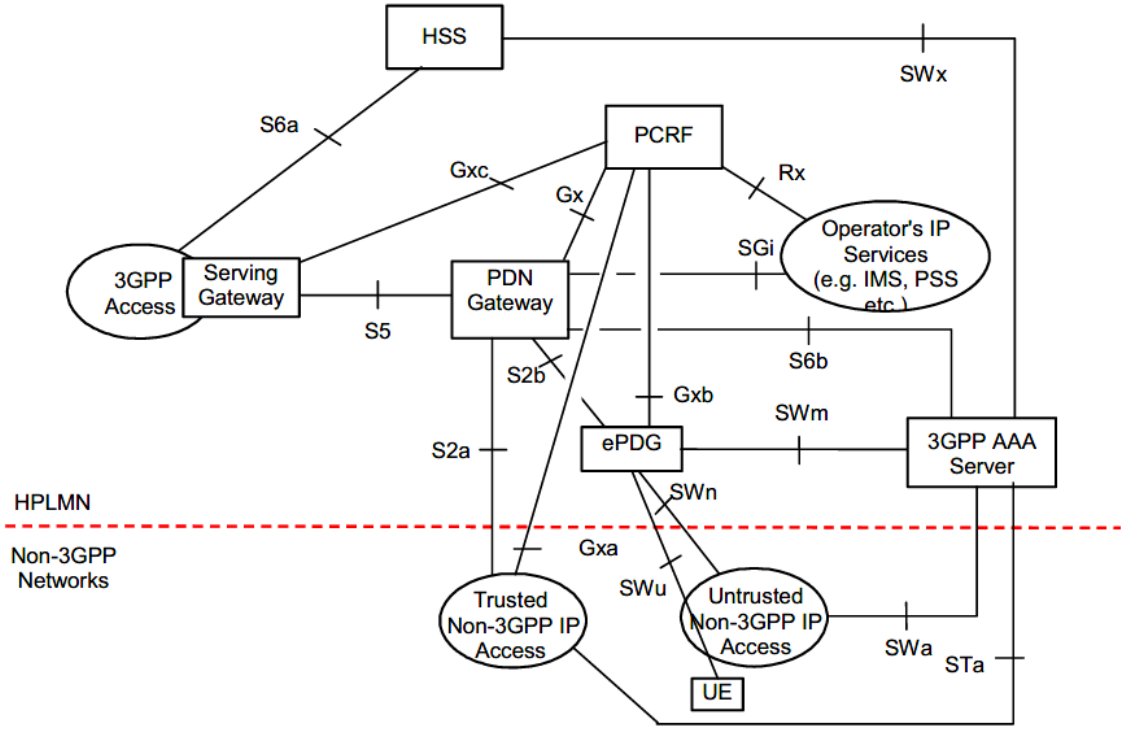


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

The PDN GW is the point of interconnect between the EPC and external IP networks. IP traffic runs through the PDN GW. The PDN GW interfaces the 3GPP AAA Server to retrieve subscriber data stored in the HSS, including location information stored in the location register.[264]

The PDN GW routes packets to and from the various packet data networks.[265]

The PDN GW provides roaming for voice and data signals to the user by selecting the LTE (outdoor) network or Wi-Fi (indoor) network in accordance with the location of the data communication terminal.[266]

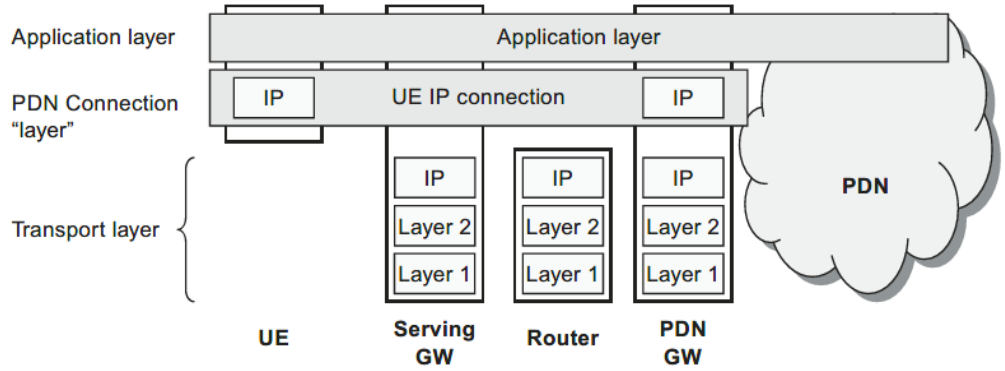


Figure 6.3: Schematic View of Application, PDN Connection, and Transport Layers for 3GPP Family of Accesses.

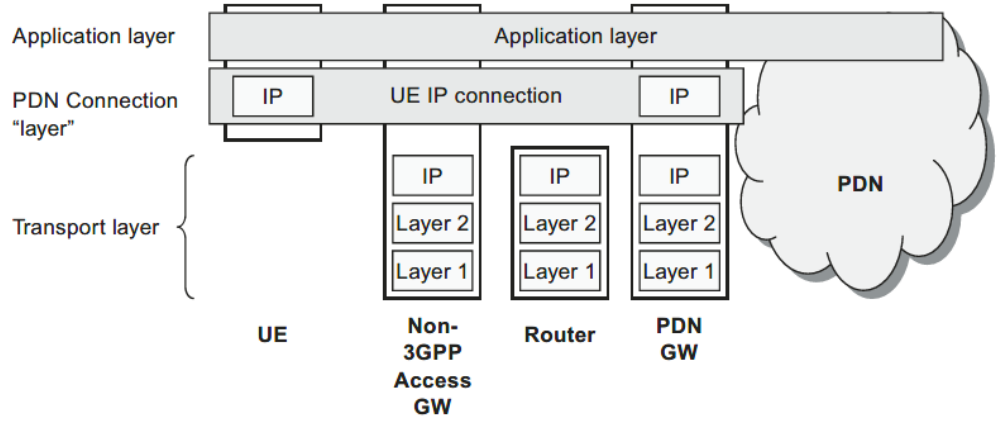


Figure 6.4: Schematic View of Application, PDN Connection, and Transport Layers for Trusted Non-3GPP Accesses When PMIP or GTP Is Used on S2a.

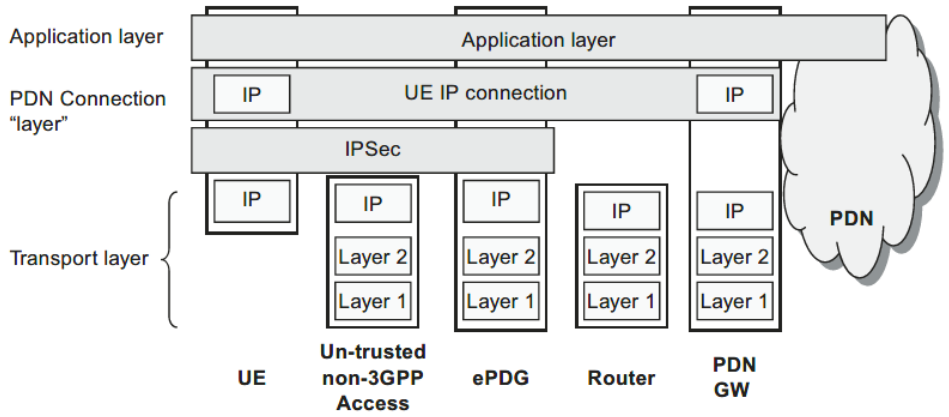


Figure 6.5: Schematic View of Application, PDN Connection, and Transport Layers for Untrusted Non-3GPP Accesses When PMIP or GTP Is Used on S2b.

The HSS "is the master user database that supports the IMS network entities that handle the calls/sessions. It contains user profiles, performs authentication and authorization of the user, and can provide information about the physical location of user."[267]

Within the EPC, the HSS connects over the SWx interface to the 3GPP AAA Server logical node, which enables other logical entities within the EPC to access the set of subscriber data stored in the HSS.[268]

The 3GPP standard illustrates this.[269]

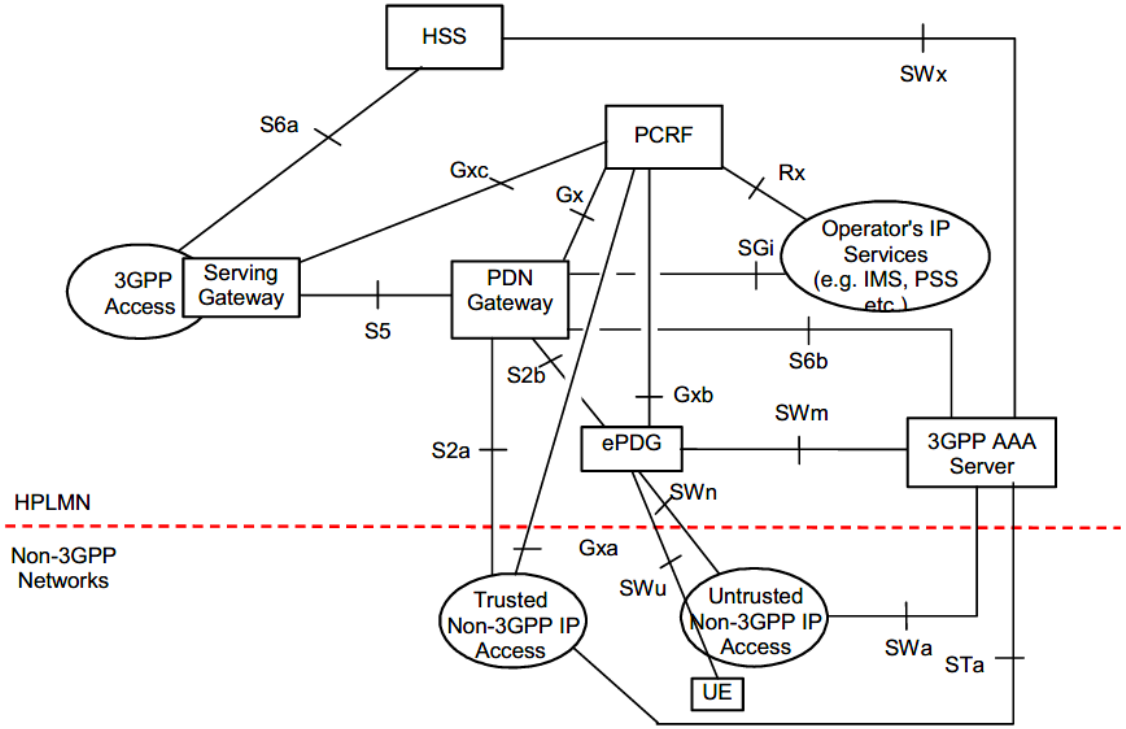


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

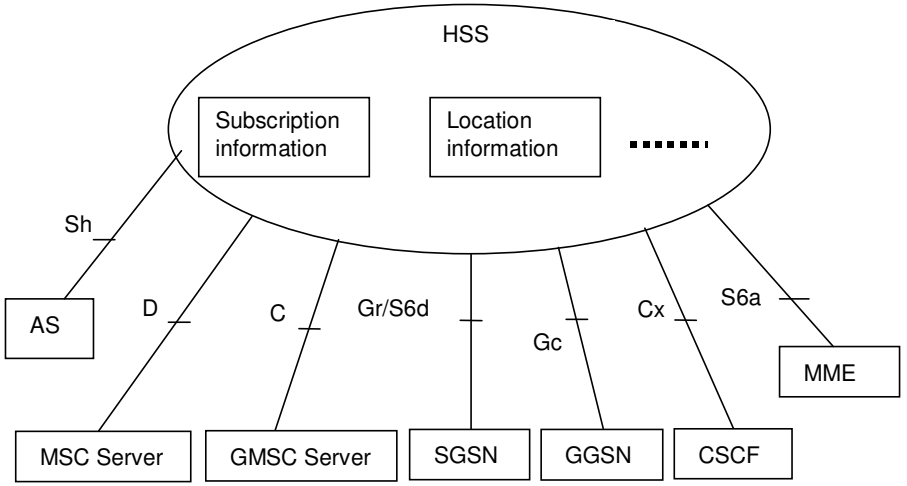
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[270]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN-Gateway (Packet Data Network Gateway) over the S6b interface; the ePDG (Evolved Packet Data Gateway) over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor). [271]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[272] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[273]



The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for 3GPP EPS (Evolved Packet System) access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[274]

As another example, the HSS stores the "subscribed QoS profile."[275]

In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[276]

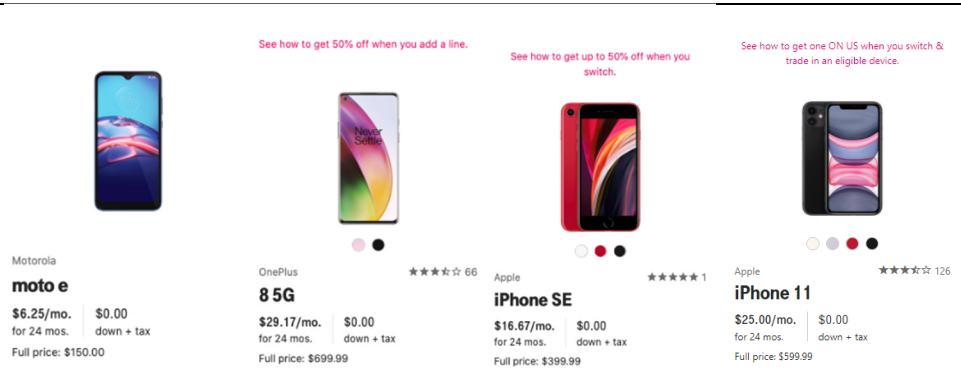
A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[277]

An APN is the label for the Wi-Fi access point.[278]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[279] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[280]

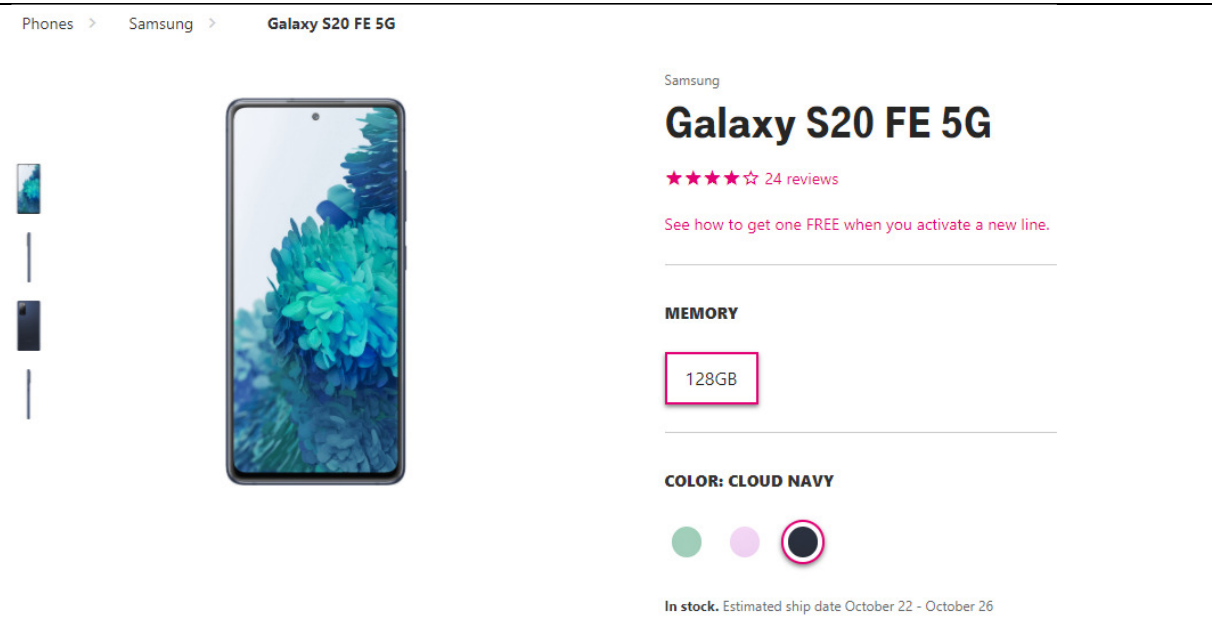
Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[281]

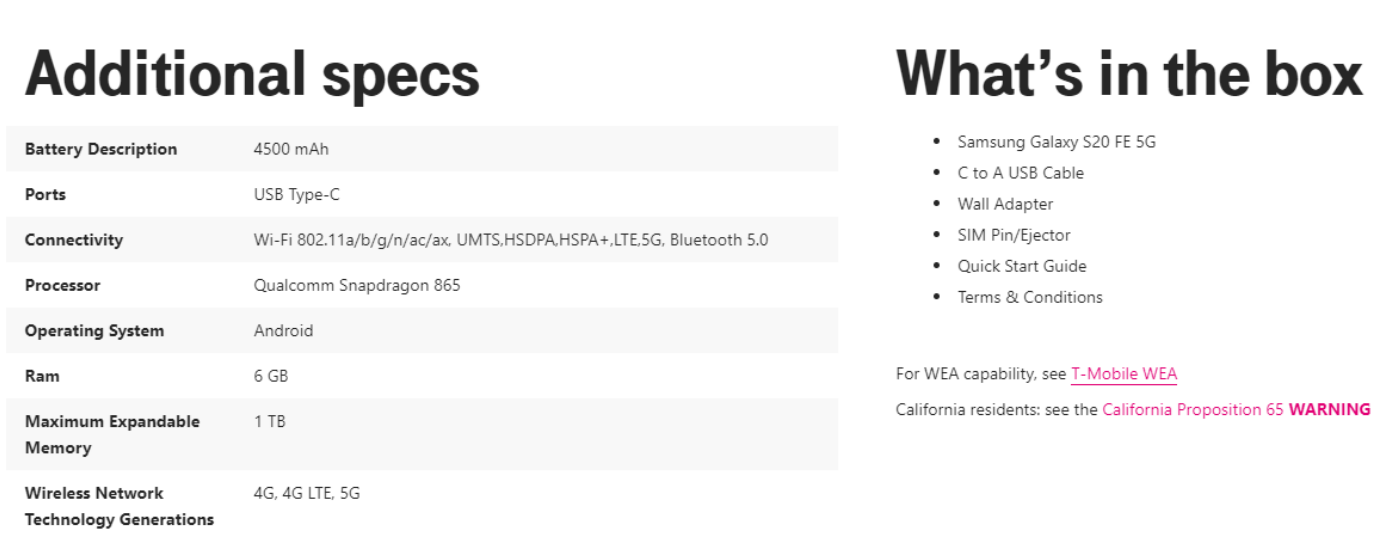
	Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[282] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[283] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[284] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. Each data communication terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor gateway" or "outdoor wireless internet network," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, indoor gateway, *supra* page 13, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
13. The internet network connecting and roaming method according to claim 12, wherein the indoor location information stored in the location register including the indoor system ID information is updated.	The Accused Instrumentalities provide the internet network connecting and roaming method, wherein the indoor location information stored in the location register including the indoor system ID information is updated. For example, the Accused Instrumentality comprises an internet network connecting and roaming method according to claim 12, as discussed above, wherein the location information including the indoor system ID information (*e.g.*, Wi-Fi Network SSID) stored in the location register is updated. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[285]



An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[286]

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[287]





The data communication terminal informs the location register that the terminal is located indoors by registering its location into the location register using a mobile IP if the registered indoor system ID information is received.

For example, Defendants provide a 5G, Extended Range 4G LTE, and 4G LTE networks.[288]

5G

- Frequencies that can provide 5G:
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  - **Band n261** (28 GHz)
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  - **Band 12** (700 MHz)
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- Our Extended Range LTE signal reaches 2X as far and penetrates walls for 4X better coverage in-buildings than ever before.

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- Frequencies that can provide LTE:
  - **Band 2** (1900 MHz)
  - **Band 5** (850 MHz)
  - **Band 4** (1700/2100 MHz)
  - **Band 66** (Extension of band 4 on 1700/2100 MHz).
- 4G LTE offers fast download speeds, up to 50% faster speeds than 3G. See **Data speeds**.
- Voice and data services only work at the same time when on you have VoLTE enabled on your device. Otherwise, LTE only provides data.

- VoLTE ("Voice over LTE") ⊕

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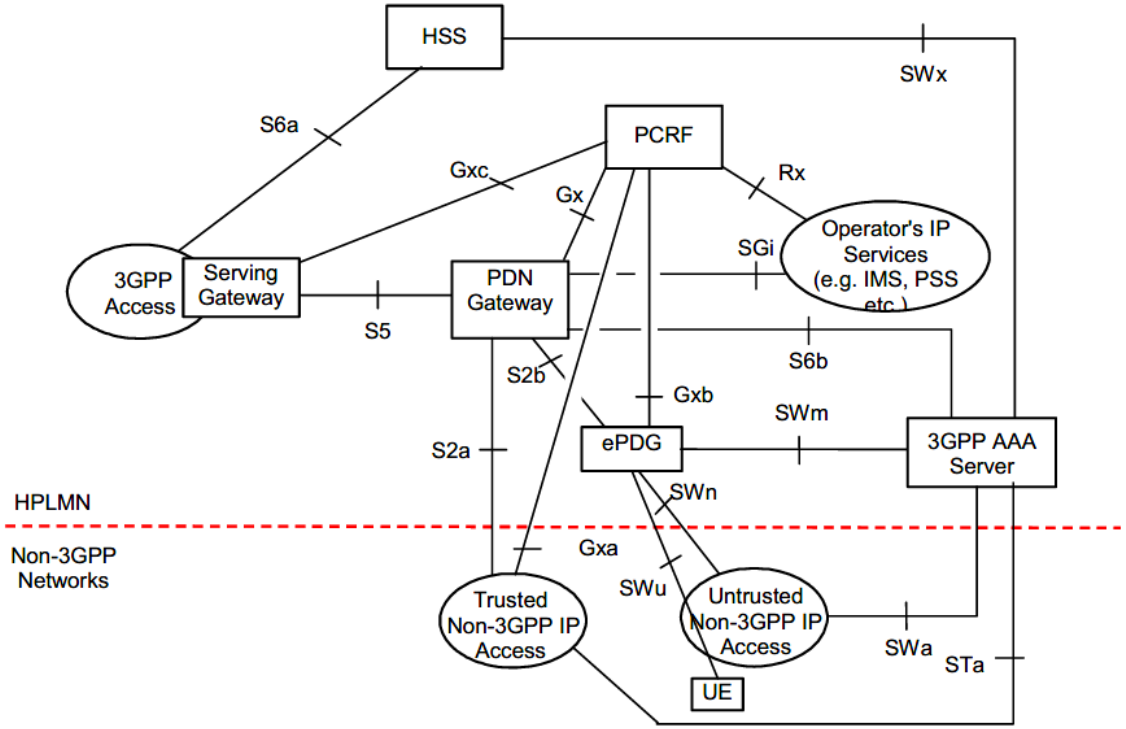


Figure 4.2.2-1: Non-Roaming Architecture within EPS using S5, S2a, S2b

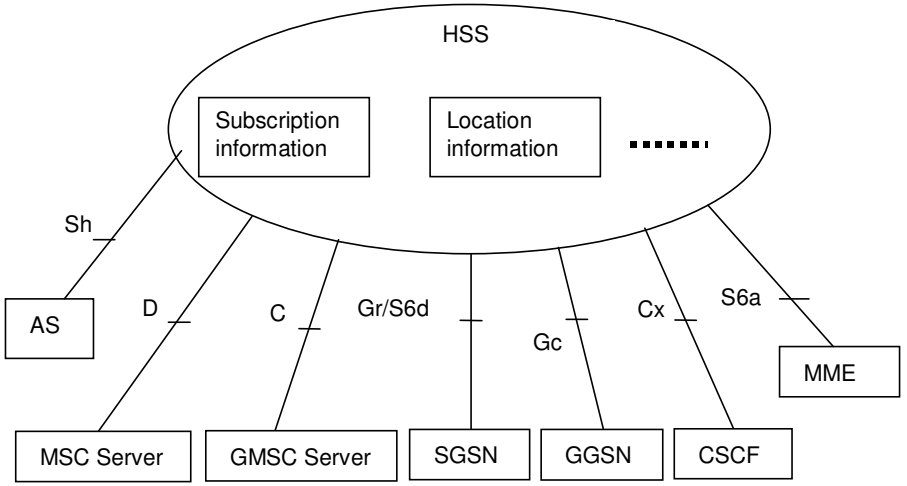
The 3GPP AAA Server may be implemented as a feature inside the HSS itself, or as stand-alone AAA equipment interfacing the HSS over the SWx interface.[293]

"UE" stands for "User Equipment" or the data communication terminal (which may also be referred to "MS" or "mobile station").

The HSS communicates through the 3GPP AAA Server, which interfaces with logical entities in the EPC, including the PDN-Gateway (Packet Data Network Gateway) over the S6b interface; the ePDG (Evolved Packet Data Gateway) over the SWm interface; Trusted Non-3GPP IP Access Networks over the STa interface; and Untrusted Non-3GPP IP Access Networks over the SWa interface. The data communication terminal updates the network about its location on a regular basis, such that the UE can access the network to make or receive calls, texts, or data, as it moves around the network (*e.g.*, between indoor and outdoor). [294]

The GMLC (Gateway Mobile Location Center) is the first node an external location application accesses in a mobile network. The GMLC performs registration authorization and requests routing information from the HSS.[295] There may be more than one GMLC.

The GMLC, HSS, and/or 3GPP AAA Server stores location information of the data communication terminal received through the indoor network or outdoor wireless internet network.[296]



The subscriber information stored in the HSS is described in 3GPP TS 23.008. Table 5.2A-1 lists the data used for packet-switched network access, such as for 3GPP EPS (Evolved Packet System) access, which includes LTE sessions. Table 5.2A-2 of 3GPP TS 23.008 lists the data used for packet-switched non-3GPP access, such as for Wi-Fi networks. The data includes location information of the data communication terminal.

For example, the HSS stores a "PDN Address."[297]

As another example, the HSS stores the "subscribed QoS profile."[298]

In addition, the HSS stores an "Access Point Name (APN)" as part of each subscriber profile.[299]

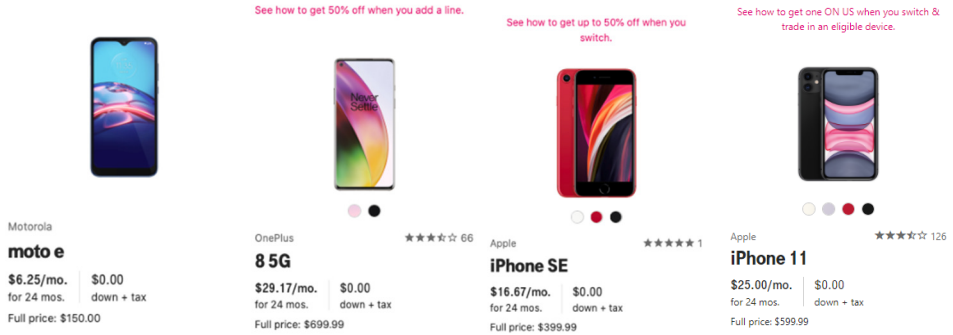
A PDN Address is an IP address assigned to the UE, when the UE joins an LTE network.[300]

An APN is the label for the Wi-Fi access point.[301]

Additionally, T-Mobile collects information about the approximate location of a user's device in relation to its cell towers and the Global Positioning System (GPS).[302] T-Mobile uses that information, as well as other usage and performance information also obtained from the network and user's Device, to provide wireless voice and data services, and to maintain and improve the network and quality of service.[303]

As another example, various forms of location information are provided by the Accused Instrumentalities, including but not limited to CID (Cell Identification) and TDOA (Time Difference of Arrival). Such location information is utilized in relation with various aspects of the Accused Instrumentalities, including but not limited to an E-SMLC (Enhanced Serving Mobile Location Center), MME (Mobility Management Entity),

	and GMLC (Gateway Mobile Location Center).[304] As yet another example, this information can be registered using Mobile IP.[305] Additionally and/or in the alternative, T-Mobile's LTE network comprises a BCE (Binding Cache Entry), flow binding information, and/or IP flow information.[306] Additionally and/or in the alternative, T-Mobile's LTE network comprises a LMA (Local Mobility Anchor) and/or HA (Home Agent).[307] Additionally and/or in the alternative, T-Mobile has deployed and continues to deploy 5G networks.[308] The Accused Instrumentalities use Mobile IP, like Dual Stack and Proxy Mobile IP, IPv6 and IPv4. Mobile IP enables IP-level mobility when moving between different access technologies (*e.g.*, from LTE to Wi-Fi).[309] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. Each location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise "indoor location information" or "indoor system ID information," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the second step, *supra* page 54, third step, *supra* page 62, and fifth step, *supra* page 78; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the location register, *supra* page 16; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.

14. The internet network connecting and roaming method according to claim 12, wherein the second step includes the step of comparing a plurality of indoor system ID informations stored in the location register with the received indoor system ID information and determining whether the received indoor system ID information is identical to any one of the stored indoor system ID informations.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the second step includes the step of comparing a plurality of indoor system ID informations stored in the location register with the received indoor system ID information and determining whether the received indoor system ID information is identical to any one of the stored indoor system ID informations. For example, the Accused Instrumentality comprises an internet network connecting and roaming method according to claim 12, as discussed above, wherein the second step includes the step of comparing a plurality of indoor system ID informations stored in the location register with the received indoor system ID information and determining whether the received indoor system ID information is identical to any one of the stored indoor system ID informations. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[310]  An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[311]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

This device includes an indoor wireless connection module, such as a Wi-Fi chip, and stores registered indoor system ID information.[312]

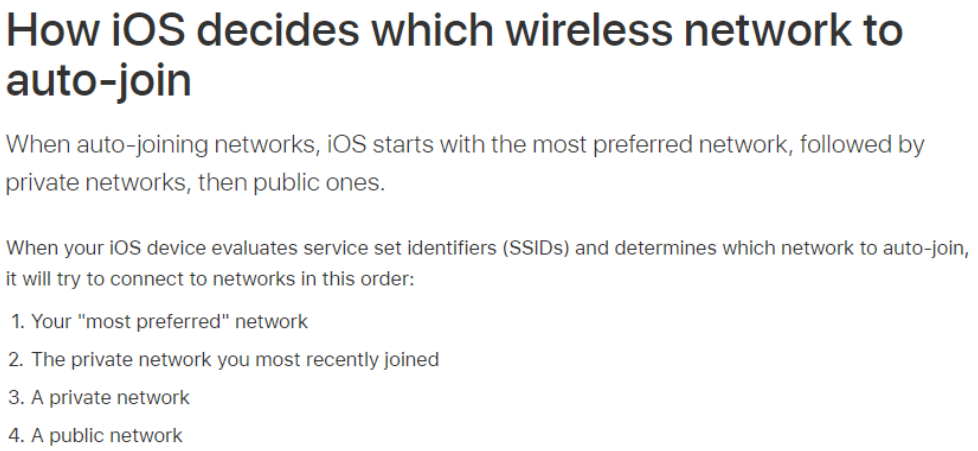
Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

This device compares a plurality of indoor system IDs with received indoor system IDs, and determines whether one or more of the received indoor system IDs matches any of the stored indoor system IDs.

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[313]



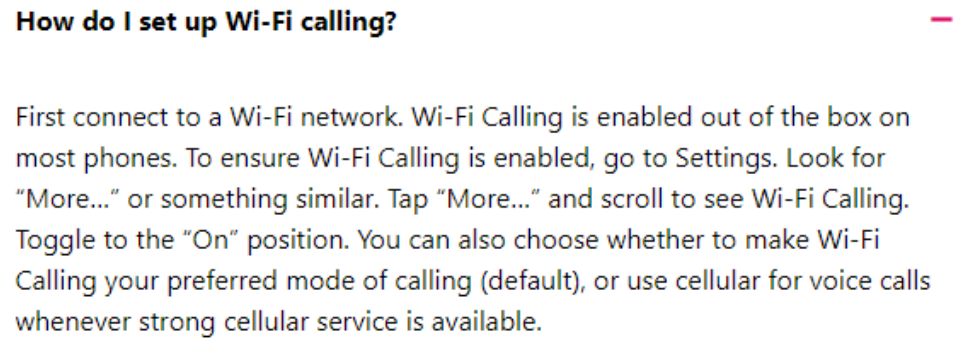
How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The device sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information.[314]



How do I set up Wi-Fi calling?

First connect to a Wi-Fi network. Wi-Fi Calling is enabled out of the box on most phones. To ensure Wi-Fi Calling is enabled, go to Settings. Look for "More..." or something similar. Tap "More..." and scroll to see Wi-Fi Calling. Toggle to the "On" position. You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.

Do I have to log into a Wi-Fi network to connect? −

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device? −

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

For example, when the device is connected to Wi-Fi, the Wi-Fi Calling feature is enabled on the device, and a cellular connection is unavailable or poor, calls will be carried over Wi-Fi.[315]

As another example, the Samsung Galaxy S20 FE G5 wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC,[316] which includes a Wi-Fi modem indoor wireless connection module.[317] The device stores registered indoor system ID information, such as a Wi-Fi network SSIDs.[318]

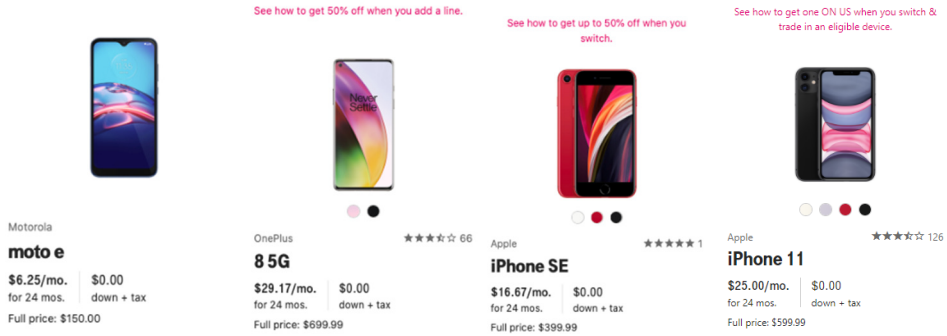
This device compares received indoor system ID information with the stored indoor system ID information. For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[319]

The device sets its own mode to one of an indoor communication mode and an outdoor communication mode depending whether the received indoor system ID information is equal to the stored indoor system ID information. For example, "[t]he primary responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[320] "The platform will ultimately decide on which network the device connects to."[321]

Each location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities.

To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise "indoor system ID informations," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused Instrumentalities provide a voice/data

	communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the second step, *supra* page 54; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
15. The internet network connecting and roaming method according to claim 14, wherein the indoor wireless connection module is housed in the data communication terminal and the indoor gateway, respectively.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 14, wherein the indoor wireless connection module is housed in the data communication terminal and the indoor gateway, respectively. For example, the Accused Instrumentality comprises an internet network connecting and roaming method according to claim 14, wherein the indoor wireless connection module is housed in the data communication terminal. Defendants sell mobile devices such as smartphones, tablets, personal computing devices, and other personal electronic devices that support both cellular and Wi-Fi calling and texting, internet network connectivity, and roaming.[322] 

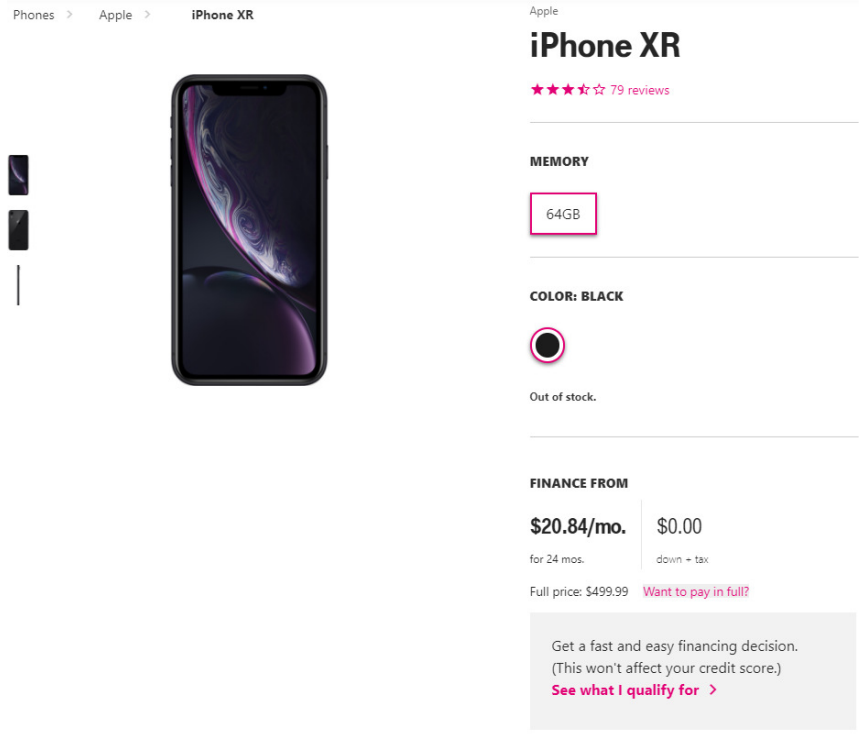
	An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[323] **Make a call with Wi-Fi Calling** With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling. To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier. This device includes an indoor wireless connection module and stores registered indoor system ID information.[324]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and Wi-Fi in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

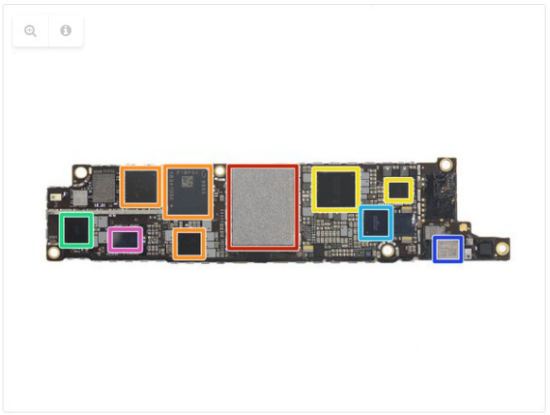
The Apple iPhone XR wireless data communication terminal includes Wi-Fi modem indoor wireless connection module.[325]

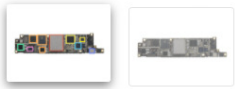


Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

Step 8





- More chips on the back side of the logic board. Show us your identification, please...
  - Toshiba TSB3243VC0428CHNA1 64 GB flash storage
  - Intel 9955 (likely the XMM7560 LTE Advanced Pro 4G LTE baseband processor), 5762 RF transceiver, and 5829
  - Apple 338S00383-A0, 338S00375-A1 power management IC's (possibly from Dialog Systems)
  - Texas Instruments SN2600B1 battery charging IC
  - Apple 338S00248 audio codec (possibly from Cirrus Logic)
  - Skyworks 13768 front end module
  - Broadcom 59355A2IUB4G (likely a variation of the BCM59350 wireless power receiver chip)

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[326]

How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The Apple iPhone stores this information so that it may be connected with the indoor wireless connection module.[327]

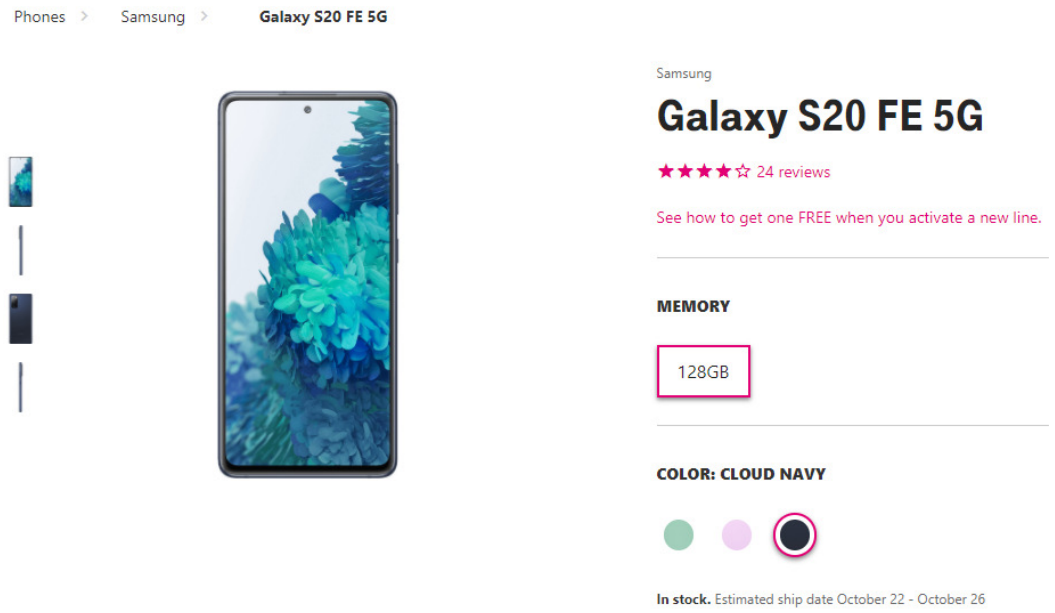
Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device?

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[328]



Additional specs

Battery Description	4500 mAh
Ports	USB Type-C
Connectivity	Wi-Fi 802.11a/b/g/n/ac/ax, UMTS,HSDPA,HSPA+,LTE,5G, Bluetooth 5.0
Processor	Qualcomm Snapdragon 865
Operating System	Android
Ram	6 GB
Maximum Expandable Memory	1 TB
Wireless Network Technology Generations	4G, 4G LTE, 5G

What's in the box

- Samsung Galaxy S20 FE 5G
- C to A USB Cable
- Wall Adapter
- SIM Pin/Ejector
- Quick Start Guide
- Terms & Conditions

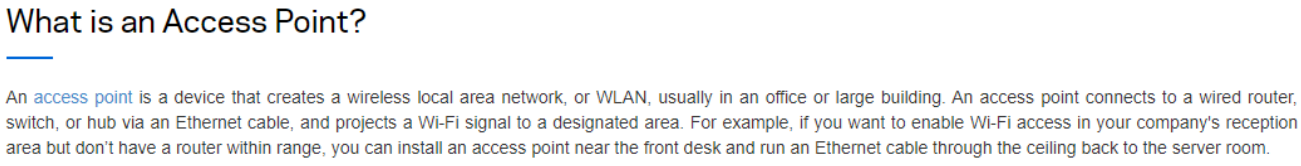
For WEA capability, see T-Mobile WEA

California residents: see the California Proposition 65 **WARNING**

The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[329]

	Qualcomm® FastConnect™ Subsystem **Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Cellular Modem** **Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system **Cellular Technology** **Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support **Wi-Fi** **Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency It is anticipated that discovery will provide further details regarding data communication terminals used, sold, offered, and/or provided by T-Mobile, including any alternative configurations and any corresponding structures in the Accused Instrumentalities. Additionally and/or in the alternative, the Accused Instrumentality comprises an internet network connecting and roaming method according to claim 14, wherein the indoor wireless connection module is housed in the indoor gateway.

An indoor gateway a wireless access point or node for connecting to a LAN and the internet with a wire, such as a home or business gateway, router, "hotspot," mesh-network node, or ad hoc network node. A Wi-Fi access point broadcasts indoor system ID information (*e.g.*, network SSID), and makes wireless communications with the data communication terminal through the indoor wireless connection module.[330]

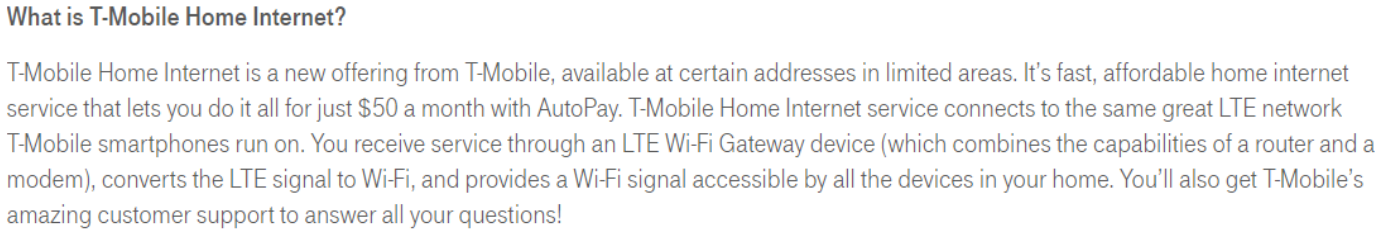


What is an Access Point?

An access point is a device that creates a wireless local area network, or WLAN, usually in an office or large building. An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area. For example, if you want to enable Wi-Fi access in your company's reception area but don't have a router within range, you can install an access point near the front desk and run an Ethernet cable through the ceiling back to the server room.

The Accused Instrumentality can be used with "any available Wi-Fi connection."[331]

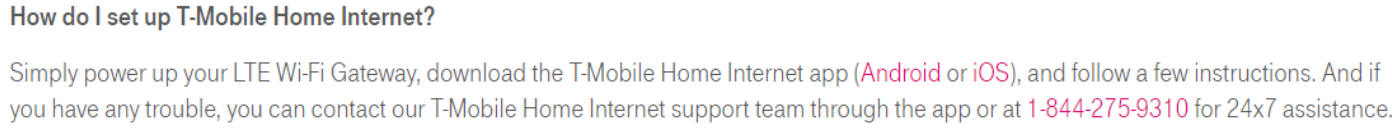
For example, Defendants provide a Wi-Fi Gateway and access to a network of nationwide Wi-Fi hotspots.[332]



What is T-Mobile Home Internet?

T-Mobile Home Internet is a new offering from T-Mobile, available at certain addresses in limited areas. It's fast, affordable home internet service that lets you do it all for just $50 a month with AutoPay. T-Mobile Home Internet service connects to the same great LTE network T-Mobile smartphones run on. You receive service through an LTE Wi-Fi Gateway device (which combines the capabilities of a router and a modem), converts the LTE signal to Wi-Fi, and provides a Wi-Fi signal accessible by all the devices in your home. You'll also get T-Mobile's amazing customer support to answer all your questions!

T-Mobile provides an indoor gateway, e.g., LTE Wi-Fi Gateway (TM-RTL0102), and Wi-Fi CellSpot Router (T-Mobile AC-1900), to its customers.[333] Furthermore, T-Mobile's indoor gateways may be connected to the internet via a wire, *see, e.g.,* T-Mobile's CellSpot "[r]equires a wired high-speed internet connection" and "[o]n the back the CellSpot has … one Gigabit WAN port (to connect to an Internet source, such as a broadband modem)"[334]



How do I set up T-Mobile Home Internet?

Simply power up your LTE Wi-Fi Gateway, download the T-Mobile Home Internet app (Android or iOS), and follow a few instructions. And if you have any trouble, you can contact our T-Mobile Home Internet support team through the app or at 1-844-275-9310 for 24x7 assistance.

T-Mobile provides Wi-Fi hotspots (for internet).[335]

T-Mobile provides Wi-Fi hotspots through Boingo Wireless ("Boingo"), "the Wi-Fi industry's leading nationwide provider of software and services."

> With the new agreement, T-Mobile Hotspot and postpaid mobile broadband subscribers will now have Wi-Fi access at no additional charge at 53 Boingo airport locations in the United States and Canada, including major airports in the New York and Chicago metropolitan areas. The expanded agreement also includes the Washington State Ferries in the Seattle area.

> Similarly, Boingo subscribers will have continued Wi-Fi access at T-Mobile Hotspot airport locations and expanded access at T-Mobile HotSpot airline club and hotel locations, including the airline clubs of American Airlines, United Airlines, US Airways and Delta Airlines and Hyatt hotels.
>
> "Expanding our agreement with T-Mobile USA reinforces our commitment to delivering customers seamless Wi-Fi access to a larger, collective footprint," said Colby Goff, senior vice president of strategy for Boingo Wireless. "We pride ourselves in listening to our customers and giving them access to Wi-Fi when and where they need it. Boingo users can now enjoy connectivity at airport lounges – a top request – and we welcome T-Mobile subscribers to our airport and ferry networks."[336]

T-Mobile also provides Wi-Fi hotspot devices, including but not limited to: T9 Mobile Hotspot and Linkzone 2.[337]

T-Mobile provides Home Internet and Wi-Fi Services:[338]

Are there ways I can't use Home Internet?

You can use your Home Internet for all the homework, streaming, and video conferencing you need! But to ensure that our network is available for all customers, there are some restrictions on activities that can damage or disproportionately congest the network. For example, Home Internet is not intended for unattended use, automatic data feeds, automated machine-to-machine connections, or uses that automatically consume unreasonable amounts of available network capacity. Please see T-Mobile's Terms and Conditions for prohibited uses.

> T-Mobile and Sprint are now part of the same family. While T-Mobile is working to build a combined network, the Sprint network continues to operate. Sprint customers' traffic may be carried in some areas by the T-Mobile network (e.g. where T-Mobile's network is available and Sprint's is not). These Sprint customers will continue to experience the network management practices disclosed on Sprint's Open Internet page, but while on the T-Mobile network can expect to experience the speeds and data prioritization disclosed on this page.
>
> ...
>
> Broadband Internet Access Services are subject to the T-Mobile Terms and Conditions at https://www.t-mobile.com/responsibility/legal/terms-and-conditions. Specific information about our Broadband Internet Access Services can be found under the heading "Using Our Network" Certain uses of our network are also prohibited as described in our Terms and Conditions under the heading "Examples of Permitted and Prohibited Uses of the Services and Your Device." E-Rate and other government or enterprise customers' use of T-Mobile's Broadband Internet Access Services may also be governed by an applicable government contract

	or Major Account Agreement.[339] Our wireless network is a shared resource, which we manage for the benefit of all of our customers. Your Data Plan is intended for Web browsing, messaging, and similar activities. Certain activities and uses of our Services and your Device are permitted and others are not. If you buy, lease, or finance a Device manufactured for use on our network, you agree, and we rely on your agreement, that you intend it to be activated on our Service and will not resell or modify the Device, or assist anyone doing so. Here are examples of permitted and prohibited uses. Permitted uses include: • Voice calls; • Web browsing; • Messaging; • Email; • Streaming music; • Uploading and downloading applications and content to and from the Internet or third party stores; • Using applications and content without excessively contributing to network congestion; and • Tethering your Device to other non-harmful devices pursuant to the terms and conditions and allotments of your Data Plan.[340] It is anticipated that discovery will provide further details regarding indoor gateways used, sold, offered, and/or provided by T-Mobile, including commercial gateway hardware, alternative configurations, and any corresponding structures in the Accused Instrumentalities. Each data communication terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. To the extent, if any, that Defendants' Accused Instrumentalities do not literally comprise an "indoor gateway" or "indoor wireless connection module," Defendants' Accused Instrumentalities provide a substantial equivalent that differs from these features in only insubstantial ways. Defendants' Accused

	Instrumentalities provide a voice/data communications network connecting and roaming system and service comprising substantially the same function (*e.g.*, providing networks, network connections, and network information of a type found in and/or associated with the "indoors" or "outdoors" of homes or businesses), in substantially the same way (*e.g.*, with shorter ranges and distances for "indoor" networks, and longer ranges and distances for "outdoor" networks), to achieve substantially the same result (*e.g.*, seamless connectivity, better communication quality with a lower cost) as the invention claimed by the '728 Patent. Therefore, even if Defendants' Accused Instrumentalities do not literally infringe these claim terms, they still infringe under the doctrine of equivalents. *See also* discussion of Claim 14, *supra* page 104; *see also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the fourth step, *supra* page 66, and fifth step, *supra* page 78; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and indoor gateway, *supra* page 13; discussion of Claim 9, *supra* page 44; discussion of Claim 10, *supra* page 44; discussion of Claim 11, *supra* page 45.
17. The internet network connecting and roaming method according to claim 12, wherein the indoor wireless connection module is a wireless LAN connection module.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the indoor wireless connection module is a wireless LAN connection module. For example, the Accused Instrumentality provides numerous indoor gateway selections comprising an indoor wireless connection module that is a wireless LAN connection module.[341] Indoor gateways listed above with regard to claim 1 comprise an indoor wireless connection module that is a wireless LAN (*i.e.*, Wi-Fi) connection module (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T9 Mobile Hotspot).[342] Additionally and/or in the alternative, the Accused Instrumentality provides numerous data communication terminals comprising an indoor wireless connection module that is a wireless LAN connection module. Data communication terminals listed above with regard to claim 1 comprise an indoor wireless connection module that is a wireless LAN (*i.e.*, Wi-Fi) connection module (*e.g.*, Alcatel Go Flip 3; Joy Tab; Joy Tab Kids; Apple iPhone 12 Pro; iPhone 12; iPhone SE; iPhone 11; iPhone 11 Pro; iPhone 11 Pro Max; iPhone XR; iPad Air; iPad 8th gen; iPad Pro 11-inch 2nd gen; iPad Pro 12.9-inch 4th gen; iPad 7th gen; iPad Air 3rd gen; iPad mini; Motorola razr 5G; moto e; OnePlus 8T+ 5G; 8 5G; Samsung Galaxy S20 FE 5G; Note20 Ultra 5G; Z Fold2 5G; Note20 5G; A71 5G; A51 5G; S20 Ultra 5G; Z Flip 5G; A21; A11; A10e; S20 5G; S20+ 5G; Galaxy Tab S7 5G; Galaxy Tab S7+ 5G; Galaxy Tab A 8.4; and T-Mobile REVVL 5G; REVVL 4+; REVVL 4.).[343] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data communication terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

	See also discussion of Claim 12, *supra* page 46, *e.g.*, regarding the fourth step, *supra* page 66, and fifth step, *supra* page 78; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and indoor gateway, *supra* page 13; discussion of Claim 9, *supra* page 44; discussion of Claim 10, *supra* page 44.
18. The internet network connecting and roaming method according to claim 17, wherein the indoor gateway is an internet communication equipment connected with either a wired or wireless LAN.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the indoor gateway is an internet communication equipment connected with either a wired or wireless LAN. For example, the Accused Instrumentality provides numerous indoor gateways which are internet communication equipment connected with either wired or wireless LAN. Indoor gateways listed above with regard to claim 1 are internet communication equipment (*i.e.*, capable of supporting communication of data, voice, and the like at short range), and are connected with either a wired or wireless LAN (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T9 Mobile Hotspot).[344] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 17, *supra* page 119; *see also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the fourth step, *supra* page 66, and fifth step, *supra* page 78; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the indoor gateway, *supra* page 13; discussion of Claim 9, *supra* page 44; discussion of Claim 10, *supra* page 44.
19. The internet network connecting and roaming method according to claim 12, wherein the indoor wireless connection module is a wireless packet communication connection module.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the indoor wireless connection module is a wireless packet communication connection module. For example, the Accused Instrumentality provides numerous indoor gateways comprising a wireless packet communication connection module. Indoor gateways listed above with regard to claim 1 include modules for wireless packet communication connections such as wireless internet and/or wireless LAN (*e.g.*, LTE Wi-Fi Gateway (TM-RTL0102), Wi-Fi CellSpot Router, Linkzone 2, and T9 Mobile Hotspot).[345] Additionally and/or in the alternative, the Accused Instrumentality provides numerous data communication terminals comprising a wireless packet communication connection module. Data communication terminals listed above with regard to claim 1 include modules for wireless packet communication connections such as wireless mobile broadband and wireless LAN (*e.g.*, Alcatel Go Flip 3; Joy Tab; Joy Tab Kids; Apple iPhone 12 Pro; iPhone 12; iPhone SE; iPhone 11; iPhone 11 Pro; iPhone 11 Pro Max; iPhone XR; iPad Air; iPad 8th gen; iPad Pro 11-inch 2nd gen; iPad Pro 12.9-inch 4th gen; iPad 7th gen; iPad Air 3rd gen; iPad mini; Motorola razr 5G; moto e; OnePlus 8T+ 5G; 8 5G; Samsung Galaxy S20 FE 5G; Note20 Ultra 5G; Z Fold2

	5G; Note20 5G; A71 5G; A51 5G; S20 Ultra 5G; Z Flip 5G; A21; A11; A10e; S20 5G; S20+ 5G; Galaxy Tab S7 5G; Galaxy Tab S7+ 5G; Galaxy Tab A 8.4; and T-Mobile REVVL 5G; REVVL 4+; REVVL 4.).[346] It is anticipated that discovery will provide further details of these features, including alternative configurations and components, in the Accused Instrumentalities. Each data communication terminal and indoor gateway referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the fourth step, *supra* page 66, and fifth step, *supra* page 78; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, and indoor gateway, *supra* page 13; discussion of Claim 9, *supra* page 44; discussion of Claim 10, *supra* page 44; discussion of Claim 11, *supra* page 45.
20. The internet network connecting and roaming method according to claim 12, wherein the second step is performed in the course of the internet communication service.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the second step is performed in the course of the internet communication service. For example, the Accused Instrumentality provides an internet network connecting and roaming method according to claim 12, wherein the second step is performed in the course of the internet communication service. An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[347]

Make a call with Wi-Fi Calling

With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling.

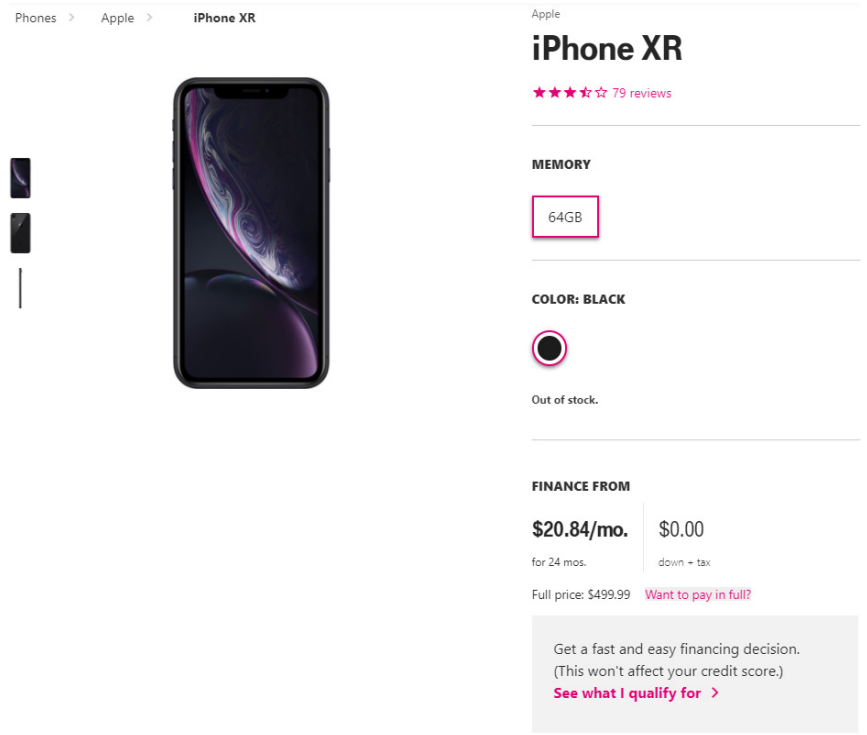
To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier.

This device includes an "indoor" wireless connection module and stores registered indoor system ID information.[348]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
2. Turn on Wi-Fi. Your device will automatically search for available Wi-Fi networks.
3. Tap the name of the Wi-Fi network that you want to join.

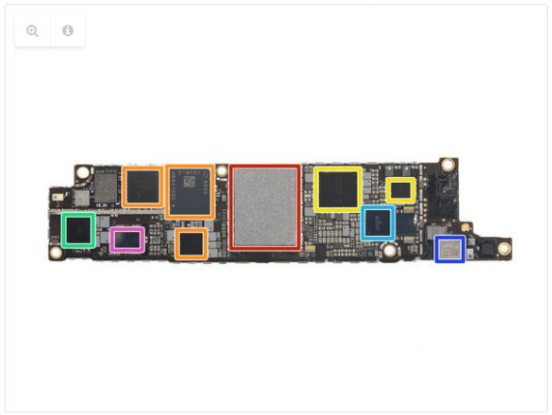
After you join the network, you'll see ✓ next to the network and in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

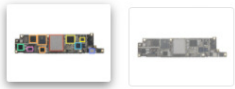
	The Apple iPhone XR wireless data communication terminal includes Wi-Fi modem indoor wireless connection module.[349] 

Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

Step 8





- More chips on the back side of the logic board. Show us your identification, please...
  - Toshiba TSB3243VC0428CHNA1 64 GB flash storage
  - Intel 9955 (likely the XMM7560 LTE Advanced Pro 4G LTE baseband processor), 5762 RF transceiver, and 5829
  - Apple 338S00383-A0, 338S00375-A1 power management IC's (possibly from Dialog Systems)
  - Texas Instruments SN2600B1 battery charging IC
  - Apple 338S00248 audio codec (possibly from Cirrus Logic)
  - Skyworks 13768 front end module
  - Broadcom 59355A2IUB4G (likely a variation of the BCM59350 wireless power receiver chip)

For example, "[w]hen your iOS device evaluates service set identifiers (SSIDs)" it "determines which networks to auto-join."[350]

How iOS decides which wireless network to auto-join

When auto-joining networks, iOS starts with the most preferred network, followed by private networks, then public ones.

When your iOS device evaluates service set identifiers (SSIDs) and determines which network to auto-join, it will try to connect to networks in this order:

1. Your "most preferred" network
2. The private network you most recently joined
3. A private network
4. A public network

The Apple iPhone stores this information so that it may be connected with the indoor network if the registered indoor system ID information is received and by connecting with the outdoor wireless internet network if the registered indoor system ID information is not received.[351]

How do I set up Wi-Fi calling?

First connect to a Wi-Fi network. Wi-Fi Calling is enabled out of the box on most phones. To ensure Wi-Fi Calling is enabled, go to Settings. Look for "More..." or something similar. Tap "More..." and scroll to see Wi-Fi Calling. Toggle to the "On" position. You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.

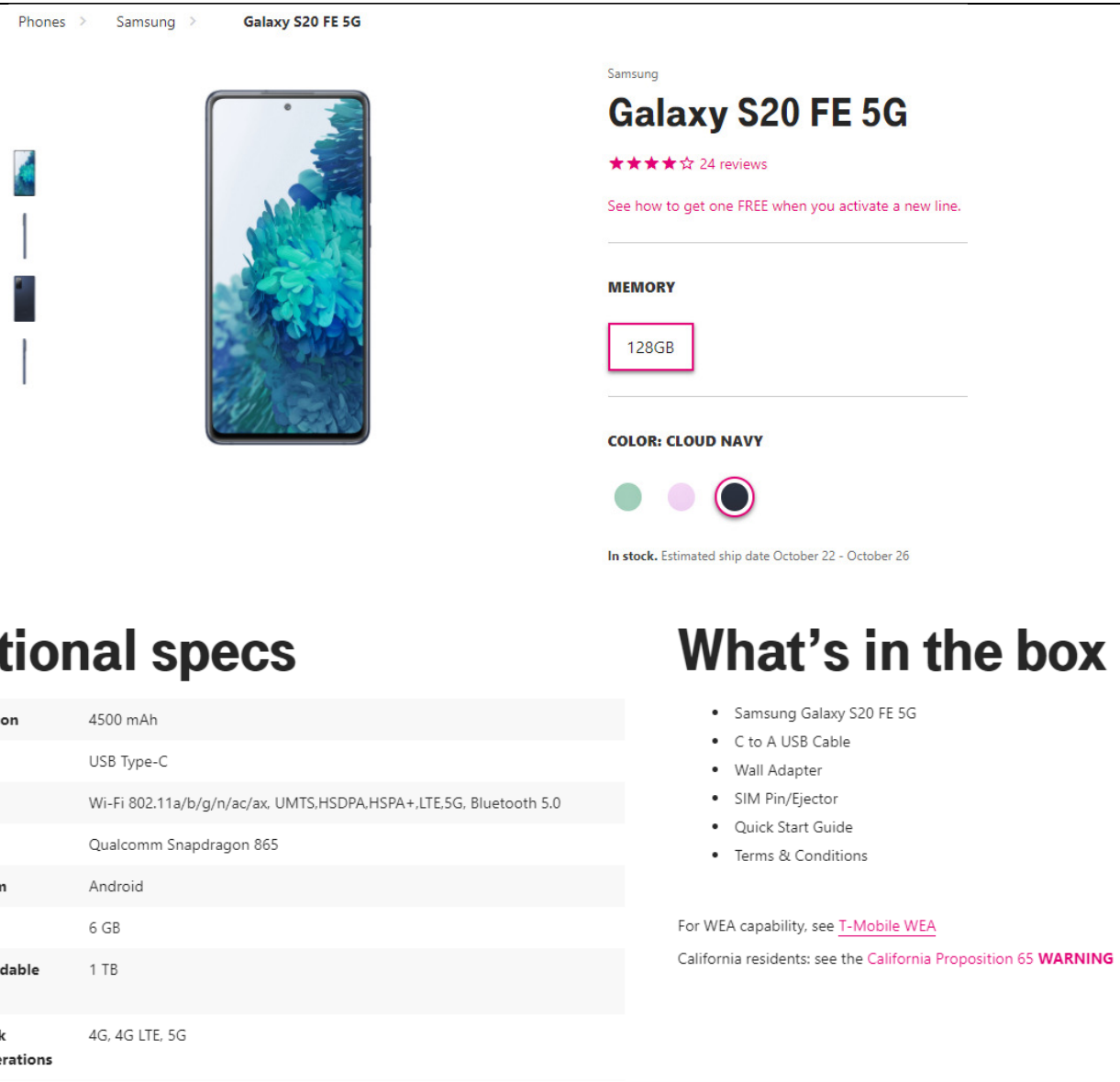
Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device?

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[352]



The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[353]

	Qualcomm® FastConnect™ Subsystem **Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Cellular Modem** **Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system **Cellular Technology** **Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support **Wi-Fi** **Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency The data communication terminals store registered indoor system ID information, such as a Wi-Fi network SSID.[354] The terminals connect with an indoor network, such as a home or office Wireless LAN or Wi-Fi network, if the registered indoor system ID information is received.[355] For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[356] If the registered indoor system ID information is not received, the terminal connects with the outdoor wireless internet network, such as T-Mobile cellular telephony system and service. For example, "[t]he primary

responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[357] "The platform will ultimately decide on which network the device connects to."[358]

For example, Defendants' Wi-Fi Calling system works automatically once enabled, and can connect anytime one connects to a Wi-Fi network. [359]

Do I have to log into a Wi-Fi network to connect?

Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on.

How do I log in to a Wi-Fi network on my device?

Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range.

According to Defendants, once Wi-Fi Calling is setup, the users' smartphone can be set to use the strongest signal, *i.e.*, Wi-Fi or cellular.[360]

How do I set up Wi-Fi calling?

First connect to a Wi-Fi network. Wi-Fi Calling is enabled out of the box on most phones. To ensure Wi-Fi Calling is enabled, go to Settings. Look for "More..." or something similar. Tap "More..." and scroll to see Wi-Fi Calling. Toggle to the "On" position. You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.

It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities.

Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar.

See also discussion of Claim 12, *supra* page 46, *e.g.*, regarding the first step, *supra* page 49, and second step, *supra* page 54; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal,

	supra page 4, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.
21. The internet network connecting and roaming method according to claim 12, wherein the second step is performed after completion of the internet communication service.	The Accused Instrumentalities provide an internet network connecting and roaming method according to claim 12, wherein the second step is performed after completion of the internet communication service. For example, the Accused Instrumentality provides an internet network connecting and roaming method according to claim 12, wherein the second step is performed after completion of the internet communication service. For example, Defendants' Wi-Fi Calling system works automatically once enabled, and can connect anytime one connects to a Wi-Fi network. [361] **Do I have to log into a Wi-Fi network to connect?** Yes, you must connect to a Wi-Fi network before your phone will automatically connect to that same network when in range. Once you've connected, you'll be automatically connected when Wi-Fi is turned on. **How do I log in to a Wi-Fi network on my device?** Go to Settings and select Wi-Fi. A list of available Wi-Fi networks will appear. Select a trusted network and enter a password to connect. After the first connection, the phone will automatically connect to that same network automatically when in range. According to Defendants, once Wi-Fi Calling is setup, the users' smartphone can be set to use the strongest signal, i.e., Wi-Fi or cellular.[362] **How do I set up Wi-Fi calling?** First connect to a Wi-Fi network. Wi-Fi Calling is enabled out of the box on most phones. To ensure Wi-Fi Calling is enabled, go to Settings. Look for "More..." or something similar. Tap "More..." and scroll to see Wi-Fi Calling. Toggle to the "On" position. You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.

	An exemplary or representative example is the Apple iPhone, which can "[m]ake a call with Wi-Fi Calling."[363] **Make a call with Wi-Fi Calling** With Wi-Fi Calling, you can make or receive a phone call if you have a Wi-Fi connection in an area with little or no cellular coverage. Learn how to make a voice call using Wi-Fi Calling. To use Wi-Fi Calling, you need an iPhone 5c or later on a supported carrier. This device includes an "indoor" wireless connection module, and stores registered indoor system ID information.[364]

Connect to a Wi-Fi network

1. From your Home screen, go to Settings > Wi-Fi.
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3. Tap the name of the Wi-Fi network that you want to join.

After you join the network, you'll see ✓ next to the network and in the upper-left corner of your display or the upper-right corner on an iPhone X and later.

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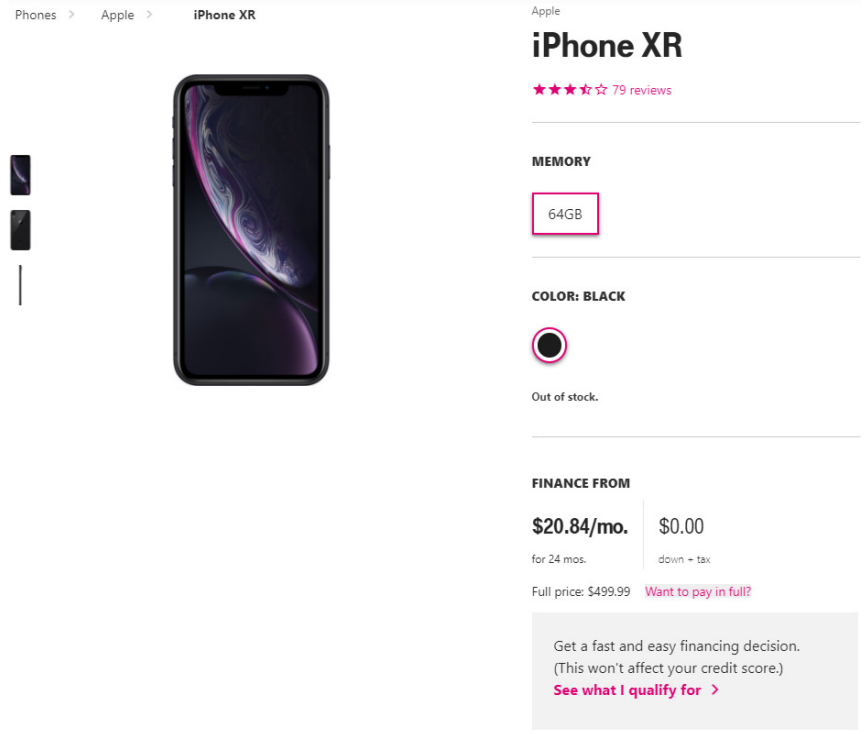
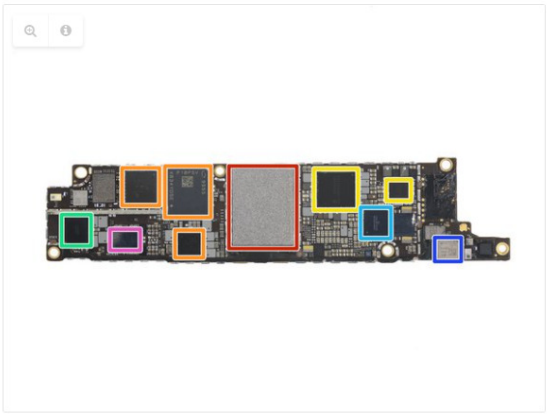
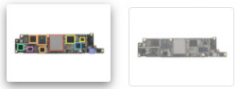


Additional specs

Battery Description	Built-in rechargeable lithium-ion battery
Ports	Lightning
Connectivity	Wi-Fi 802.11ac with MIMO, Bluetooth 5.0, NFC, LTE, USB
Processor	A12 Bionic Chip
Operating System	iOS
Ram	64 GB
Maximum Expandable Memory	0 GB
Wireless Network Technology Generations	4G, 4G LTE
Supported Email Platforms	Apple Mail, POP3, IMAP4, SMTP, Microsoft® Exchange, AOL®, AIM, Yahoo! ® Mail, GMail
Hearing Aid Compatibility	M3, T4
WEA Capable	true
Mobile Hotspot Capable	true
Frequency	GSM: 850 MHz, 900 MHz, 1800 MHz, 1900 MHz; UMTS: Band I (2100), Band II (1900), Band IV (1700/2100), Band V (850), Band VIII (900); LTE: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 34, 38, 39, 40, 41, 46, 66, 71

Step 8





- More chips on the back side of the logic board. Show us your identification, please...
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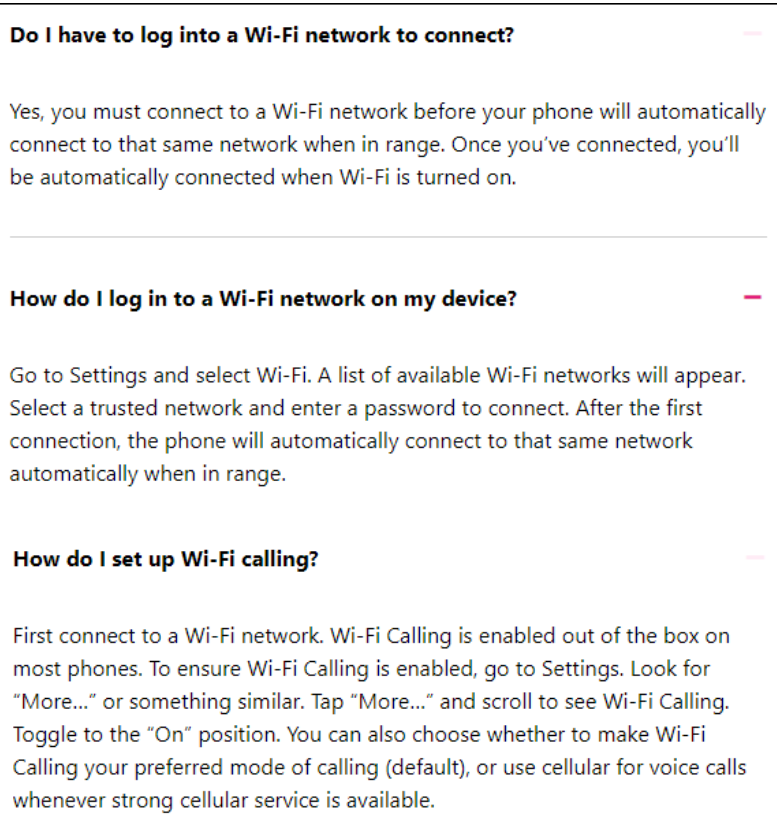

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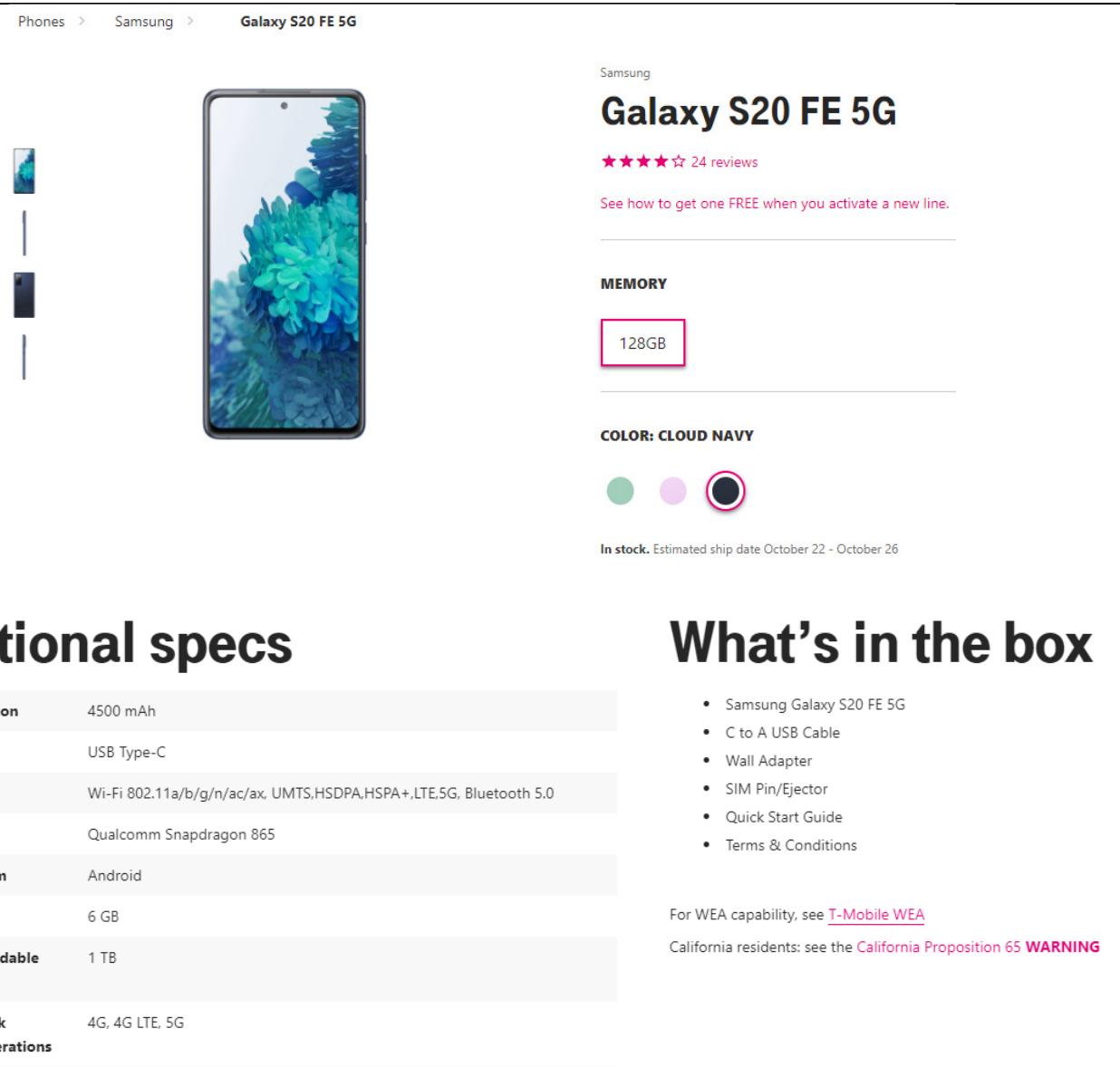
As another example, the Samsung Galaxy S20 FE 5G wireless data communication terminal includes a Qualcomm Snapdragon 865 SoC.[368]



The Snapdragon 865 SoC includes a Wi-Fi modem indoor wireless connection module.[369]

	Qualcomm® FastConnect™ Subsystem **Wi-Fi/Bluetooth Subsystem:** Qualcomm® FastConnect™ 6800 **60 GHz Wi-Fi features:** Always-on Wi-Fi sensing, Wire-equivalent latency **Bluetooth Features:** 1-to-many Bluetooth broadcast, Qualcomm TrueWireless™ Stereo, Bluetooth 5.1, Qualcomm® aptX™ Voice audio for super wide band voice calls, Qualcomm® aptX™ Adaptive Audio **Wi-Fi 6 features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Cellular Modem** **Modem Name:** Qualcomm® Snapdragon™ X55 5G modem-RF system **Cellular Technology** **Cellular Technology:** HSPA, WCDMA, TD-SCDMA, CDMA 1x, EV-DO, GSM/EDGE **LTE Technology:** LTE including CBRS support **Wi-Fi** **Wi-Fi Standards:** Wi-Fi 6, Wi-Fi 6-ready, 802.11ad, 802.11ay, 802.11ac Wave 2, 802.11a/b/g, 802.11n **Qualcomm® Wi-Fi 6 technology features:** MU-MIMO (Uplink and Downlink), 8x8 sounding, OFDMA (Uplink and Downlink), 1024 QAM, Dual-band simultaneous (DBS), WPA3 security support, Target Wake Time **Wi-Fi Spectral Bands:** 2.4 GHz, 5 GHz, 60 GHz **Peak Speed:** 10 Gbps **Qualcomm® 60 GHz Wi-Fi technology features:** Always-on Wi-Fi sensing, Wire-equivalent latency The data communication terminals store registered indoor system ID information, such as a Wi-Fi network SSID.[370] The terminals connect with an indoor network, such as a home or office Wireless LAN or Wi-Fi network, if the registered indoor system ID information is received.[371] For example, "[a]pps can set a combination of network matching params: SSID Pattern . . . AND/OR BSSID Pattern . . . to trigger connection to a network that matches the set params."[372] If the registered indoor system ID information is not received, the terminal connects with the outdoor wireless internet network, such as T-Mobile's cellular telephony system and service. For example, "[t]he primary

	responsibilities of this class are to: . . . Attempt to 'fail over' to another network when connectivity to a network is lost."[373] "The platform will ultimately decide on which network the device connects to."[374] It is anticipated that discovery will provide further details of the features of this method step, including alternative configurations and functions, in the Accused Instrumentalities. Each data communication terminal and location register referenced herein is believed to comprise a structure and operates in a fashion that is the same or substantially similar. *See also* discussion of Claim 12, *supra* page 46, *e.g.*, regarding the first step, *supra* page 49, and second step, *supra* page 54; *see also* discussion of Claim 1, *supra* page 1, *e.g.*, regarding the data communication terminal, *supra* page 4, location register, *supra* page 16, and router, *supra* page 21; discussion of Claim 2, *supra* page 25; discussion of Claim 4, *supra* page 32; discussion of Claim 5, *supra* page 39.

[1] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/offers/wifi-calling-wifi-extenders).

[2] *Id.*

[3] *Id.*

[4] KAIFI_0004430 (Magnus Olsson, et al., *EPC and 4G Packet Networks, Driving the Mobile Broadband Revolution*, ELSEVIER (2d ed. 2012)), at 41.

[5] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 41; *see also supra* note 1 ("You can also choose whether to make Wi-Fi Calling your preferred mode of calling (default), or use cellular for voice calls whenever strong cellular service is available.").

[6] *Id.*

[7] KAIFI_0054224 - KAIFI_0054236] (*Terms and Conditions*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/responsibility/legal/terms-and-conditions).

[8] KAIFI_0054237 - KAIFI_0054241 (*Binge on Streaming Video*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/offers/binge-on-streaming-video); KAIFI_0054242 - KAIFI_0054244] (*Unlimited Video Streaming with Binge On*, T-Mobile (last visited Oct. 20, 2020), https://www.t-mobile.com/support/plans-features/unlimited-video-streaming-with-binge-on); *see also supra* note 1.

[9] *See* KAIFI_0054245 - KAIFI_0054248 (*America's Largest 5G Network*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/coverage/4g-lte-5g-networks); KAIFI_0054249 - KAIFI_0054250 (*5G & 4G LTE Coverage Map, T-Mobile* (last visited Oct. 20, 2020), https://www.t-mobile.com/coverage/coverage-map).

[10] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[11] KAIFI_0054251 - KAIFI_0054253 (*Wi-Fi Calling from T-Mobile*, T-Mobile (last visited Oct. 20, 2020), https://www.t-mobile.com/support/coverage/wi-fi-calling-from-t-mobile).

[12] KAIFI_0054274 - KAIFI_0054275 (*Apple iPhone 12 Pro*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-12-pro?sku=194252036440); KAIFI_0054296 - KAIFI_0054297 (*Apple iPhone 12*, T-Mobile (last visited Oct. 28, 2020), https://www.t-

mobile.com/cell-phone/apple-iphone-12?sku=194252028124); KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-s20-fe-5g?sku=610214666376); KAIFI_0054322 - KAIFI_0054323 (*OnePlus 8T+ 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/oneplus-8t-plus-5g?sku=610214665409); KAIFI_0054324 - KAIFI_0054325 (*Apple iPhone SE*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-se?sku=190199503458); KAIFI_0054326 - KAIFI_0054327 (*Samsung Galaxy Note20 Ultra 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-note20-ultra-5g?sku=610214665355); KAIFI_0054328 - KAIFI_0054329 (*Motorola razr 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/motorola-razr-5g?sku=610214665225); KAIFI_0054330 - KAIFI_0054331 (*T-Mobile REVVL 5G,* T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/t-mobile-revvl-5g?sku=610214664839); KAIFI_0054332 - KAIFI_0054333 (*Samsung Galaxy Z Fold2 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-z-fold2-5g?sku=610214666161); KAIFI_0054254 - KAIFI_0054255 (*T-Mobile REVVL 4+*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/t-mobile-revvl-4-plus?sku=610214664846); KAIFI_0054256 - KAIFI_0054257 (*T-Mobile REVVL 4*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/t-mobile-revvl-4?sku=610214665959); KAIFI_0054258 - KAIFI_0054259 (*OnePlus 8 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/oneplus-8-5g?sku=610214663818); KAIFI_0054260 - KAIFI_0054261 (*Samsung Galaxy Note20 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-note20-5g?sku=610214665294); KAIFI_0054262 - KAIFI_0054263 (*Samsung Galaxy A71 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-a71-5g?sku=610214664426); KAIFI_0054264 - KAIFI_0054265 (*Samsung Galaxy A51 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-a51-5g?sku=610214664747); KAIFI_0054266 - KAIFI_0054267 (*Motorola moto e*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/motorola-moto-e?sku=610214663436); KAIFI_0054268 - KAIFI_0054269 (*Apple iPhone 11*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-11?sku=190199219991); KAIFI_0054270 - KAIFI_0054271 (*Samsung Galaxy S20 Ultra 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-s20-ultra-5g?sku=610214663320); KAIFI_0054272 - KAIFI_0054273 (*Samsung Galaxy Z Flip 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-z-flip-5g?sku=610214665980); KAIFI_0054276 - KAIFI_0054277 (*Apple iPhone 11 Pro*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-11-pro?sku=190199388093); KAIFI_0054278 - KAIFI_0054279 (*Apple iPhone 11 Pro Max*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-11-pro-max?sku=190199380349); KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/apple-iphone-xr?sku=194252139929); KAIFI_0054282 - KAIFI_0054283 (*Samsung Galaxy A21*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-a21?sku=610214664358); KAIFI_0054284 - KAIFI_0054285 (*Samsung Galaxy A11*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-a11?sku=610214664372); KAIFI_0054286 - KAIFI_0054287 (*Samsung Galaxy A10e*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-a10e?sku=610214661180); KAIFI_0054288 - KAIFI_0054289 (*Samsung Galaxy S20 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-s20-5g?sku=610214663405); KAIFI_0054290 - KAIFI_0054291 (*Samsung Galaxy S20+ 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/samsung-galaxy-s20-plus-5g?sku=610214663351); KAIFI_0054292 - KAIFI_0054293 (*Alcatel Go Flip 3*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/cell-phone/alcatel-go-flip-3?sku=610214661463); KAIFI_0054294 - KAIFI_0054295 (*Apple iPad Air*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-air?sku=190199791770); KAIFI_0054298 - KAIFI_0054299 (*Apple iPad 8th gen*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-8th-gen?sku=190199810549); KAIFI_0054300 - KAIFI_0054301 (*Samsung Galaxy Tab S7 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/samsung-galaxy-tab-s7-5g?sku=610214666079); KAIFI_0054302 - KAIFI_0054303 (*Samsung Galaxy Tab S7+ 5G*, T-Mobile (last visited Oct. 28, 2020), https://www.t-

mobile.com/tablet/samsung-galaxy-tab-s7-plus-5g?sku=610214666062); KAIFI_0054304 - KAIFI_0054305 (*Apple iPad Pro 11-inch 2nd gen*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-pro-11-inch-2nd-gen?sku=190199657298); KAIFI_0054306 - KAIFI_0054307 (*Apple iPad Pro 12.9-inch 4th gen*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-pro-12-9-inch-4th-gen?sku=190199657915); KAIFI_0054308 - KAIFI_0054309 (*Apple iPad 7th gen*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-7th-gen?sku=190199250260); KAIFI_0054310 - KAIFI_0054311 (*Apple New iPad mini*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-new-ipad-mini?sku=190199072305); KAIFI_0054312 - KAIFI_0054313 (*Apple iPad Air 3rd Gen*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/apple-ipad-air-3rd-gen?sku=190199088436); KAIFI_0054314 - KAIFI_0054315 (*Alcatel Joy Tab™ Kids*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/alcatel-joy-tab-kids?sku=610214662712); KAIFI_0054316 - KAIFI_0054317 (*Samsung Galaxy Tab A 8.4*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/samsung-galaxy-tab-a-8-4?sku=610214704696); KAIFI_0054320 - KAIFI_0054321 (*Alcatel Joy Tab™*, T-Mobile (last visited Oct. 28, 2020), https://www.t-mobile.com/tablet/alcatel-joy-tab?sku=610214661333).

[13] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE (Apr. 3, 2019), https://support.apple.com/en-us/HT203032).

[14] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE (Mar. 31, 2019), https://support.apple.com/en-us/HT202639).

[15] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR,* T-Mobile), *supra* note 12 ; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT (last visited Oct. 20, 2020), https://www.ifixit.com/Teardown/iPhone+XR+Teardown/114123).

[16] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE (Nov. 9, 2017), https://support.apple.com/en-us/HT202831).

[17] *See* KAIFI_0054342 - KAIFI_0054343 (*Wi-Fi Calling on a Corporate Network*, T-Mobile (last visited Oct. 20, 2020), https://www.t-mobile.com/support/coverage/wi-fi-calling-on-a-corporate-network); KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[18] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[19] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, Qualcomm (last visited Oct. 21, 2020), https://www.qualcomm.com/products/snapdragon-865-5g-mobile-platform).

[20] *WifiManager*, ANDROID DEVELOPERS (last visited Aug. 28, 2019), https://developer.android.com/reference/android/net/wifi/WifiManager.

[21] *Id.*

[22] *WifiNetworkSpecifier*, ANDROID DEVELOPERS (last visited Aug. 28, 2019), https://developer.android.com/reference/android/net/wifi/WifiNetworkSpecifier; *see also Wi-Fi Infrastructure Features*, ANDROID DEVELOPERS (last visited Aug. 28, 2019), https://source.android.com/devices/tech/connect/wifi-infrastructure ("The list of available network rating providers is available to the user . . . . The user may select one or none of them. If none are available or selected, the *Connect to open networks* feature is disabled.").

[23] *ConnectivityManager*, ANDROID DEVELOPERS (last visited Aug. 28, 2019), https://developer.android.com/reference/android/net/ConnectivityManager.html; *see also What Is Smart Network Switching?*, SAMSUNG (Apr. 11, 2019), https://www.samsung.com/au/support/mobile-devices/what-is-smart-network-switching/ ("The Smart Network switch enables your device to switch from an unstable Wifi network to use Mobile Data.").

[24] *WifiManager*, ANDROID DEVELOPERS, *supra* note 20.

[25] *See supra* note 12.

[26] KAIFI_0000101 (*What Is an Access Point and How Is It Different from a Range Extender?*, LINKSYS (last visited Aug. 28, 2019), https://www.linksys.com/us/r/resource-center/what-is-a-wifi-access-point/).

[27] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[28] KAIFI_0054349 - KAIFI_0054350 (*T-Home Internet FAQs*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/isp/FAQs); KAIFI_0054351 - KAIFI_0054352 (*Airport Wi-Fi at LAX*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/support/plans-features/airport-wi-fi-at-lax); KAIFI_0054353 - KAIFI_0054354 (*Gogo In-Flight Wi-Fi and Texting Included*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/offers/gogo-inflight); KAIFI_0054355 (*Boingo Expands Wi-Fi Roaming Agreement with T-Mobile USA*, Business Wire (last visited Oct. 21, 2020), https://www.businesswire.com/news/home/20101201005625/en/Boingo-Expands-Wi-Fi-Roaming-Agreement-with-T-Mobile-USA).

[29] KAIFI_0054349 - KAIFI_0054350 (*T-Home Internet FAQs*, T-Mobile), *supra* note 28.

[30] *Id.*; KAIFI_0054356 (*How to configure Quality of Service T-Mobile LTE Wi-Fi Gateway TM-RTL0102*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/support/tutorials?page=device/t-mobile/lte-wi-fi-gateway-tm-rtl0102/topic/expert-settings/how-to-configure-quality-of-service/1); KAIFI_0054357 - KAIFI_0054362 (*Web User Interface: T-Mobile LTE Wi-Fi Gateway*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/support/devices/web-user-interface-t-mobile-lte-wi-fi-gateway); KAIFI_0054363 - KAIFI_0054367 (*Wi-Fi CellSpot Router Setup & Help*, T-Mobile (last visited, Oct. 22, 2020), https://www.t-mobile.com/support/coverage/wi-fi-cellspot-router-setup-andamp-help); KAIFI_0054368 - KAIFI_0054372 (*T-Mobile (AC-1900) by ASUS Wireless AC-1900 Dual-Band Gigabit Router,* Walmart.com (last visited Oct. 22, 2020), https://www.walmart.com/ip/t-mobile-ac-1900-by-asus-wireless-ac1900-dual-band-gigabit-router-aiprotection-with-trend-micro-for-complete-network-security/839102688).

[31] KAIFI_0054373 - KAIFI_0054375 (*Now get Wi-Fi that works like a T-Mobile tower*, T-Mobile (last visited Oct. 26, 2020), https://www.t-mobile.com/business/coverage/wi-fi-calling-wifi-extenders); KAIFI_0054376 - KAIFI_0054380 (*T-Mobile Personal CellSpot Review*, CNet (last visited Oct. 26, 2020), https://www.cnet.com/reviews/t-mobile-personal-cellspot-review/).

[32] KAIFI_0054353 - KAIFI_0054354 (*Gogo In-Flight Wi-Fi and Texting Included*, T-Mobile), *supra* note 28; KAIFI_0054355 (*Boingo Expands Wi-Fi Roaming Agreement with T-Mobile USA*, Business Wire), *supra* note 28.

[33] KAIFI_0054355 (*Boingo Expands Wi-Fi Roaming Agreement with T-Mobile USA*, Business Wire), *supra* note 28.

[34] KAIFI_0054381 - KAIFI_0054382 (*Franklin T9 Mobile Hotspot*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/tablet/franklin-t9-mobile-hotspot?sku=610214660763); KAIFI_0054383 - KAIFI_0054384 (*Alcatel Linkzone 2*, T-Mobile (last visited Oct. 22, 2020), https://www.t-mobile.com/tablet/alcatel-linkzone-2?sku=610214663740);

[35] KAIFI_0054349 - KAIFI_0054350 (*T-Home Internet FAQs*, T-Mobile), *supra* note 28.

[36] KAIFI_0054385 - KAIFI_0054394 (*Policies Open Internet*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/responsibility/consumer-info/policies/internet-service).

[37] KAIFI_0054224 - KAIFI_0054236 (*Terms and Conditions*, T-Mobile), *supra* note 7.

[38] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile (last visited Oct. 21, 2020), https://www.t-mobile.com/support/coverage/t-mobile-network).

[39] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38, 41.

[40] KAIFI_0001830 (Stefano Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*, ORACLE (last visited Aug. 28, 2019), https://www.oracle.com/technetwork/testcontent/home-subscriber-server-083038.html).

[41] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[42] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[43] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[44] *Id.* at 121.

[45] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 345.

[46] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[47] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[48] *Id.*

[49] *Id.* at Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[50] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS (last visited Aug. 28, 2019), https://www.netmanias.com/en/post/techdocs/7246/lte/lte-ip-address-allocation-schemes-i-basic).

[51] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[52] KAIFI_0054397 - KAIFI_0054439 (*In the Matter of T-Mobile USA, Inc., Notice of Apparent Liability and Forfeiture and Admonishment*, File No.: EB-TCD-18-00027702, FCC (Feb. 28, 2020), available at: https://docs.fcc.gov/public/attachments/FCC-20-27A1.pdf), at 6.

[53] *Id.*

[54] *See* KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 46, 340–48.

[55] *See, e.g.*, *id.*, at 109–114, 138–146, 173–175, 448–454.

[56] *See, e.g.*, *id.*, at 382–385, 462–467.

[57] *See supra* note 9.

[58] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[59] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[60] *Id.*

[61] *Id.*

[62] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 41, Fig. 2.16.

[63] KAIFI_0001089 (3GPP TS 23.402, Release 15), Figure 4.2.2-1.

[64] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[65] KAIFI_0001827 (Frédéric Firmin, *The Evolved Packet Core*, 3GPP (last visited Aug. 28, 2019), http://www.3gpp.org/technologies/keywords-acronyms/100-the-evolved-packet-core).

[66] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at Figs. 6.3–6.5.

[67] *See supra* note 9.

[68] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[69] *See supra* note 12.

[70] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[71] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[72] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[73] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[74] KAIFI_0054251 - KAIFI_0054253 (*Wi-Fi Calling from T-Mobile*, T-Mobile), *supra* note 11.

[75] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[76] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, QUALCOMM), *supra* note 19.

[77] *See supra* note 20.

[78] *See supra* note 22.

[79] *See supra* note 23.

[80] *See supra* notes 20, 23.

[81] *See supra* note 12.

[82] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[83] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[84] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[85] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[86] *See supra* note 20.

[87] *See supra* note 12.

[88] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[89] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[90] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile), *supra* note 8.

[91] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38, 41.

[92] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[93] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[94] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[95] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[96] *Id.* at 121.

[97] *Id.* at 345.

[98] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[99] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[100] *Id.*

[101] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[102] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[103] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[104] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note52.

[105] *Id.*

[106] *See* KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 46, 340–48.

[107] *See, e.g.*, *id.* at 105–07.

[108] *See, e.g.*, *id.* at 109–114, 138–146, 173–175, 448–454.

[109] *See, e.g.*, *id.* at 382–385, 462–467.

[110] *See supra* note 9.

[111] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[112] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[113] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[114] *See, e.g.*, *id.* at 140, 170–82.

[115] *See, e.g.*, *id.* at 43.

[116] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[117] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[118] *Id.* at 121.

[119] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 345.

[120] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[121] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[122] *Id.*

[123] *Id.* at Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[124] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[125] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[126] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note 52.

[127] *Id.*

[128] *See, e.g.*, KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 109–114, 138–146, 173–175, 448–454.

[129] *See, e.g.*, *id.* at 382–385, 462–467.

[130] *See supra* note 9.

[131] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[132] KAIFI_0001854 (Olivier Hersent, *IP Telephony: Deploying VoIP Protocols & IMS Infrastructure* (2d ed. 2011)), at 288–98.

[133] KAIFI_0001522 (3GPP TS 29.279, Release 9 (Jan. 2010)) § 3.1.

[134] *See supra* page 13.

[135] *See supra* note 28, 29, and 30.

[136] *Supra* note 1.

[137] KAIFI_0054440 (*T-Mobile Home Internet*, T-Mobile (last visited Oct. 24, 2020), https://www.t-mobile.com/support/content/dam/t-mobile/c2-archives/2020/t-mobile-home-internet).

[138] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[139] *Id.* at Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[140] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[141] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[142] *See, e.g.*, KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 109–114, 138–146, 173–175, 448–454.

[143] *See, e.g.*, *id.* at 382–385, 462–467.

[144] *See supra* note 9.

[145] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[146] *See supra* page 13.

[147] KAIFI_0007165 (’728 Patent), at 9:1–2.

[148] *See supra* page 13.

[149] *See supra* page 13.

[150] *See supra* page 4.

[151] *See supra* page 13.

[152] *See supra* page 13.

[153] *See supra* page 4.

[154] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[155] *Id.*

[156] *Id.*

[157] *See supra* note 4.

[158] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 41.

[159] *Id.*

[160] KAIFI_0054224 - KAIFI_0054236 (*Terms and Conditions*, T-Mobile), *supra* note 7.

[161] *See supra* note 8.

[162] *See supra* note 9.

[163] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[164] *See supra* note 12.

[165] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[166] *See id.*

[167] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[168] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile), *supra* note 38.

[169] *See supra* note 12.

[170] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[171] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[172] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[173] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[174] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[175] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[176] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, QUALCOMM), *supra* note 19.

[177] *See supra* note 20.

[178] *Id.*

[179] *See supra* note 22.

[180] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile), *supra* note 38.

[181] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38, 41.

[182] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[183] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[184] *See, e.g.*, *id.* at 140, 170–82.

[185] *See, e.g.*, *id.* at 43.

[186] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[187] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[188] *Id.* at 121.

[189] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 345.

[190] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[191] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[192] *Id.*

[193] *Id.* at Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[194] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[195] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[196] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note 52.

[197] *Id.*

[198] *See, e.g.*, KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 109–114, 138–146, 173–175, 448–454.

[199] *See, e.g.*, *id.* at 382–385, 462–467.

[200] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[201] *See supra* note 12.

[202] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[203] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[204] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12 KAIFI_0054334 - KAIFI_0054341 (*iPhone X Teardown*, IFIXIT), *supra* note 15.

[205] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[206] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[207] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[208] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, Qualcomm), *supra* note 19.

[209] *See supra* note 20.

[210] *Id.*

[211] *See supra* note 22.

[212] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[213] *Id.*

[214] *Id.*

[215] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 41, Fig. 2.16.

[216] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[217] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[218] KAIFI_0001827 (Firmin, *The Evolved Packet Core*, 3GPP), *supra* note 65.

[219] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at Figs. 6.3–6.5.

[220] *See supra* note 9.

[221] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[222] KAIFI_0000101 (*What Is an Access Point and How Is It Different from a Range Extender?*, LINKSYS), *supra* note 26.

[223] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[224] *See supra* note 28.

[225] *Supra* note 30.

[226] KAIFI_0054373 - KAIFI_0054375 (*Now get Wi-Fi that works like a T-Mobile tower*, T-Mobile); KAIFI_0054376 - KAIFI_0054380 (*T-Mobile Personal CellSpot Review*, CNet), *supra* note 31.

[227] *Supra* note 32.

[228] *Supra* note 33.

[229] *Supra* note 34.

[230] *Supra* note 35.

[231] *Supra* note 36.

[232] *Supra* note 37.

[233] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[234] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[235] *See, e.g.*, *id.* at 140, 170–82.

[236] *See, e.g.*, *id.* at 43.

[237] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[238] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[239] *Id.* at 121.

[240] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 345.

[241] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[242] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[243] *Id.*

[244] *Id.* at Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[245] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[246] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[247] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note 52.

[248] *Id.*

[249] *See* KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 46, 340–48.

[250] *See, e.g.*, *id.* at 109–114, 138–146, 173–175, 448–454.

[251] *See, e.g.*, *id.* at 382–385, 462–467.

[252] *See supra* note 9.

[253] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[254] *See supra* note 12.

[255] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[256] *See id.*

[257] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[258] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile), *supra* note 38.

[259] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38, 41.

[260] *See supra* note 23.

[261] *See supra* note 20.

[262] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 41, Fig. 2.16.

[263] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[264] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[265] KAIFI_0001827 (Firmin, *The Evolved Packet Core*, 3GPP), *supra* note 65.

[266] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at Figs. 6.3–6.5.

[267] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[268] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[269] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[270] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[271] *Id.* at 121.

[272] *Id.* at 345.

[273] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[274] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[275] *Id.*

[276] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[277] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[278] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[279] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note 52.

[280] *Id.*

[281] *See, e.g.*, KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 109–114, 138–146, 173–175, 448–454.

[282] *See, e.g.*, KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 382–385, 462–467.

[283] *See supra* note 9.

[284] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[285] *See supra* note 12.

[286] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[287] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[288] KAIFI_0054395 - KAIFI_0054396 (*T-Mobile Network*, T-Mobile), *supra* note 38.

[289] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38, 41.

[290] KAIFI_0001830 (Giola, *Understanding the Home Subscriber Server (HSS) Sh Interface*), *supra* note 40.

[291] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[292] KAIFI_0001089 (3GPP TS 23.402), Figure 4.2.2-1.

[293] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 38.

[294] *Id.* at 121.

[295] *Id.* at 345.

[296] *See, e.g.*, KAIFI_0001089 (3GPP TS 23.002), Section 4.1.1 and Figure 0-a.

[297] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[298] *Id.*

[299] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-2; KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 277.

[300] KAIFI_0000001 (*LTE IP Address Allocation Schemes*, NETMANIAS), *supra* note 50.

[301] KAIFI_0000631 (3GPP TS 23.008), Table 5.2A-1.

[302] KAIFI_0054397 - KAIFI_0054439 (*Notice of Apparent Liability and Forfeiture and Admonishment*, FCC), *supra* note 52.

[303] *Id.*

[304] *See* KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 46, 340–48.

[305] *See, e.g.*, *id.* at 105–07.

[306] *See, e.g.*, *id.* at 109–114, 138–146, 173–175, 448–454.

[307] *See, e.g.*, *id.* at 382–385, 462–467.

[308] *See supra* note 9.

[309] KAIFI_0004430 (Olsson, *EPC and 4G Packet Networks*), *supra* note 4, at 447.

[310] *See supra* note 12.

[311] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[312] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[313] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[314] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[315] *Id.*

[316] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[317] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, Qualcomm), *supra* note 19.

[318] *See supra* note 20.

[319] *See supra* note 22.

[320] *See supra* note 23.

[321] *See supra* notes 20, 23.

[322] *See supra* note 12.

[323] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[324] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[325] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[326] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[327] *See KAIFI_0054221 - KAIFI_0054223* (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[328] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[329] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, QUALCOMM), *supra* note 19.

[330] KAIFI_0000101 (*What Is an Access Point and How Is It Different from a Range Extender?*, LINKSYS), *supra* note 26.

[331] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[332] *See supra* note 28.

[333] *Supra* note 30.

[334] KAIFI_0054373 - KAIFI_0054375 (*Now get Wi-Fi that works like a T-Mobile tower*, T-Mobile); KAIFI_0054376 - KAIFI_0054380 (*T-Mobile Personal CellSpot Review*, CNet), *supra* note 31.

[335] *Supra* note 32.

[336] *Supra* note 33.

[337] *Supra* note 34.

[338] *Supra* note 35.

[339] *Supra* note 36.

[340] *Supra* note 37.

[341] *See supra* page 12.

[342] *See supra* page 12.

[343] *See supra* page 4.

[344] *See supra* page 12.

[345] *See supra* page 12.

[346] *See supra* page 4.

[347] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[348] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[349] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[350] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[351] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[352] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note 12.

[353] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, QUALCOMM), *supra* note 19.

[354] *See supra* note 20.

[355] *Id.*

[356] *See supra* note 22;.

[357] *See supra* note 23.

[358] *See supra* note 20.

[359] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[360] *Id.*

[361] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[362] *Id.*

[363] KAIFI_0000021 (*Make a Call with Wi-Fi Calling*, APPLE), *supra* note 13.

[364] KAIFI_0000012 (*Connect to Wi-Fi on Your iPhone, iPad, or iPod Touch*, APPLE), *supra* note 14.

[365] KAIFI_0054280 - KAIFI_0054281 (*Apple iPhone XR*, T-Mobile), *supra* note 12; KAIFI_0054334 - KAIFI_0054341 (*iPhone XR Teardown*, IFIXIT), *supra* note 15.

[366] KAIFI_0000019 (*How iOS Decides Which Wireless Network to Auto-Join*, APPLE), *supra* note 16.

[367] KAIFI_0054221 - KAIFI_0054223 (*Wifi Calling Wifi Extenders*, T-Mobile), *supra* note 1.

[368] KAIFI_0054318 - KAIFI_0054319 (*Samsung Galaxy S20 FE 5G*, T-Mobile), *supra* note12.

[369] KAIFI_0054344 - KAIFI_0054348 (*Snapdragon 865 5G Mobile Platform*, QUALCOMM), *supra* note 19.

[370] *See supra* note 20.

[371] *Id.*

[372] *See supra* note 22.

[373] *See supra* note 23.

[374] *See supra* note 20.